

THE
Psychological Review

EDITED BY

JOHN B. WATSON, JOHNS HOPKINS UNIVERSITY
HOWARD C. WARREN, PRINCETON UNIVERSITY (*Index*)
JAMES R. ANGELL, UNIVERSITY OF CHICAGO (*Monographs*) AND
SHEPHERD I. FRANZ, GOVT. HOSP. FOR INSANE (*Bulletin*)

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THE PSYCHOLOGICAL REVIEW

AN EXPERIMENTAL CONTRIBUTION TO THE INVESTIGATION OF THE SUBCONSCIOUS¹

BY LILLIEN J. MARTIN

Leland Stanford Junior University, California

The subconscious is so often referred to and so little attention has been given to investigating it experimentally that it has seemed to me a condensed summary of a recent investigation I have made, might possibly be of some interest.

In making this study the image method was employed. That is, to state very briefly the mode of procedure: in one half of the experiments the observer, usually with his eyes closed or blindfolded and seated opposite the experimenter, was instructed to sit in a relaxed position and let an image (visual or auditory, memory or imaginative, etc., depending upon what was desired by the experimenter), arise of itself. The observer was not only not to arouse the image but he was not even to know its content until he saw it before him, and only those images were noted where such instructions had been entirely complied with. In the other half of the experiments, the observer was directed to arouse the image, that is, for example he was instructed to decide on the particular thing he wished to visualize and to arouse the corresponding image.

Stanford and Munich University students acted as observers.

An examination of the data regarding the content of the images, their mode of arising, etc., shows:

¹ For fuller details of the investigation as to the theory underlying it, the methods used, the experimental data, etc., see Martin, 'Ein experimenteller Beitrag zur Erforschung des Unterbewussten (Barth) and Über die Abhängigkeit visueller Vorstellungsbilder vom Denken,' *Zeit. für Psych.*, 70, 212.

1. The subconscious mental activity reveals itself through the arising of images where the observer did not previously know whether anything would be imaged, or if so, what it would be ; also, in the arising of unwilled (spontaneous) images in connection with those willed.

2. Evidently, sometimes and in some persons, the subconscious thinking responds more quickly to the task set than does the conscious. This is shown by the spontaneous images arising more promptly than do the willed. That is, the spontaneous image is before the observer before he has decided what image to arouse or it arises in place of it.

3. The images show that not only the conscious but the subconscious mental activity differs in richness of content in different individuals.

4. In case of all the observers—but in some of them more than in others—some of the material stored away under the threshold has evidently remained as originally grouped, as for example, when the visual image of a particular man in a particular environment arises simultaneously and at once. On the other hand, some of the material has evidently been more or less broken up, as for example, where an eye arises spontaneously, when an imagination image of a face is asked and no other features followed it until aroused by a special act of will on the part of the observer. In case of some of the observers the broken-up memory material, the memory elements, have been unconsciously (as shown by the observer's great surprise at the content of the visual images which arise) recombined under the threshold into complicated and appropriate new groups. There has been not alone a breaking up of memory material but, to use Ribot's words, an 'unconscious elaboration' of it. In the observers with whom I have experimented, the memory activity evidently predominates both below and above the threshold of consciousness.

5. The memory and imagination material under the threshold is evidently not all on the same stratum or level as regards consciousness, for some of it arises much more spontaneously and quickly and has a different content. Here too individuality plays a great rôle.

6. From what has been said it will be seen, that the image method makes it possible to obtain information regarding the past life of the individual, the general character and the personal peculiarities of the thinking going on in his mind, not alone above but also below the threshold of consciousness. The applicability of this method in the case of a particular person will of course depend upon his ability and habit as regards the imaging of his conscious and subconscious thinking.

7. The introspections show that the spontaneous images are sometimes the point of departure of the willed images, that is, the involuntary image that arises before the observer has decided what to will acts in the way of suggestion. This shows how important the spontaneous images must be in our daily life. Where the spontaneous images are in the direction of the work in hand, they must save time in that they arise immediately and furnish material already elaborated. On the other hand, if they are not of such a character that they can be used directly in the intellectual work being carried on or as points of departure for conscious thinking along the desired line, they must be an interruption and even a hindrance in the continuing of such thinking. The results show also that the spontaneous images may furnish ideals as regards action. In this respect they may and may not be entirely helpful. One of the observers who took part in these experiments, has very strong and insistent spontaneous auditory images. So insistent are they, that she tells me that they led to her giving up the study of music to which she had devoted several years, and turning to a totally different field of work. She says, that whenever she plays on the piano the spontaneous auditory images precede what she is playing and show her how imperfect is her execution.

8. A comparison of the content of the voluntary images with that of those which are spontaneous, shows that in the case of the visual images of a given observer what is above and below the threshold of consciousness is not materially different.

This result does not support Binet's¹ theory regarding the nature of the subconscious, which is, that there are two personalities running side by side, one above and the other below the threshold of consciousness, as what is above and below the threshold of consciousness, as was said, seems in the case of these observers not to be materially different. It may be otherwise in pathological persons, of course. Cases of double personality certainly suggest this. But such special cases do not give Binet's theory any great universality. Nor does Meyers's² theory, which has found support among workers in psychical research, that the subconscious is an expression of the infinite mind, and the conscious an individual matter or a very limited expression of the infinite, get support, for, as was just said, what is under the threshold does not seem enormously richer in content than what is above. Nor do I find anything in these results which leads me to suppose that under the threshold a mental condition exists which makes it necessary to suppose that communication between different persons (telepathy) is possible and which would more or less support Meyer's theory. The results do support Prince's³ theory that what is under the threshold is an expression of the observer's previous experiences.

9. The results have a farther interest from the standpoint of general psychology.

A. They show that the differences and likenesses between spontaneous and voluntary images ought not to be overlooked in psychology, as has been the case in the past, since through the study and comparison of such images we may go below the threshold of consciousness and get information regarding what is going on there.

B. They throw light on what is called inattention and vacillation of attention. We see that, sometimes at least, this grows out of the fact that the person has a flood of spontaneous images and ideas, which impede and even crowd out voluntary images and ideas. They explain why the genius is so impatient of restraint and may sometimes actually get

¹ On double consciousness, etc.

² 'Human Personality,' I., 34 ff., 1904.

³ 'The Subconscious,' 1 ff., 1914.

on faster by letting himself go, and also why the student in a field of an exacting and foreign character as regards his natural thinking, must take himself in hand or fail altogether in his work. I take the following in the way of illustration from what one of the observers gave to protocol:—

“Als sich mein Studium begann, war es mir kaum möglich, mich in einer Vorlesung irgendwie zu konzentrieren, weil ich beständig durch spontan auftretende V. gestört wurde. Ich habe dann versucht, die spontanen V. zu verdrängen und grosse Mühe darauf verwendet und habe es darin bis zu einer gewissen Fertigkeit gebracht, so dass ich jetzt spontane V. willkürlich haben oder nicht haben kann. Sobald ich mich aber etwas gehen lasse, sind die spont. da, und ich bin ziemlich machtlos dagegen.”

C. The data obtained lead one to ask whether in future memory investigations along quantitative lines the task of the investigation will not be something more than a filling in of the gap left in the work of an Ebbinghaus and a Müller, something more than a building upon the results already obtained by them. May we not possibly be obliged to begin again at the very bottom and repeat the work in order to feel sure of its foundations. It would seem from these results that instructions given by an experimenter favorable to voluntary effort, or the belief on the part of the observer that he must put forth his will in connection with the task set, while favorable to voluntary memory may have been detrimental to spontaneous memory and vice versa. In short, it does not seem entirely impossible that two persons may have equally good memories as regards the amount that can be reproduced, but that like instructions, as for example, that effort (resp. no effort) is to be used in reproducing a given material, may make it appear that one person has a much better memory than the other or indeed that neither has a good memory.

D. Again, these results put in question the results of certain experiments of Rux,¹ which were inspired by Ach. Rux has attempted to measure the strength of will by using

¹ ‘Ueber das assoziative Aequivalent der Determination,’ *Untersuchungen zur Psychologie und Philosophie*, Bd. II.

the quantitative data derived from memory experiments without apparently making any attempt to show how much of the work done was accomplished by voluntary and how much by spontaneous memory.

10. The results have a pedagogical interest.

A. In that they show that it is possible to educate and enrich the subconscious.

B. In that they lead one to ask whether we may not sometimes be placing too much emphasis on the employment of will in connection with the intellectual work to be done. When the student's work is of a creative nature or along the line of discovery and his spontaneous thinking and images are in harmony with the field in which he is working, one can think that the director of a leading institution in America which is devoted to scientific research, showed psychological acumen, when he urged the investigators working under him to take each day some time away from their work not only to give their minds rest but to free themselves from the restraint of thinking in one particular narrow line.

THE IMAGE METHOD VERSUS THE AUTOMATIC WRITING AND SPEAKING METHODS OF PENETRATING BELOW THE THRESHOLD OF CONSCIOUSNESS

Binet and others have used the automatic writing method, in investigating the subconscious. As the image method will naturally come in competition with the automatic writing method in investigations along this line, I have thought it desirable to make some experiments by this method to ascertain how it compares as regards the amount of data yielded with the visual image method in the getting of information of what is going on under the threshold of consciousness.

The experimental results I have given in the work of which this paper is a summary. They show (1) that while theoretically the subconscious experience is reproduced through automatic writing without entering consciousness, to be certain that this actually occurred, that is, to be certain that the experience did not enter consciousness and after such entrance more or less influence and direct the writing, one must have

observers who have the ability and the training to introspect very accurately. (2) That the image method has a much wider applicability, as it can be employed with any one who has visual and other images, while the automatic writing method, as is shown by these experiments and by others, is very limited in its application. In these experiments only 2 out of the 19 persons were really able to respond to the task set. (3) The image method gives more information in a given period of time and thereby decreases the difficulty of the introspection. (4) In the image method the experience is brought above the threshold and the observer is encouraged to give his full attention to what occurs, and he may be directed to observe particular things. (5) In the image method it is not necessary to direct the movement connected with the giving of the information into an entirely new channel by substituting the action of lower nerve centers (centers connected with subconscious thinking) for the higher (centers connected with conscious thinking) which usually largely direct it. (6) In a confirmatory way the writing method may be made very useful. The great richness, for example, of what is under the threshold of consciousness in case of M. and O. is shown by both methods. (7) Each method also brings things to the attention not brought out by the other method. The tendency of the writing movements to be at the disposal of what is in consciousness is, for example, very noticeable in case of some observers. In case of M. and O., what is below the threshold evidently plays also a rôle as regards the writing.

AUTOMATIC SPEAKING METHOD VERSUS THE IMAGE METHOD

Of some special cases of automatic speaking I have given illustrations in my study entitled '*Die Projektionsmethode*' (p. 5, 105). From what is heard by the patient himself or by the experimenter, an idea can be obtained of course of what is going on under the threshold of consciousness. The words occasionally unconsciously spoken by a normal person give one a similar idea. It will be at once evident, however, without any comparative experiments that the image method has a very much broader field of usefulness because of the diffi-

culty of getting an adequate distraction in using the automatic speaking method.

THE IMAGE METHOD VERSUS THE PATHOLOGICAL AND THE
PSYCHOANALYTICAL METHODS OF INVESTIGATING THE
SUBCONSCIOUS

The other methods of investigating the subconscious I find less satisfactory than the automatic writing and speaking methods. The objection to the pathological method, where the data regarding the subconscious is obtained for example from cases of double personality, is the feeling of doubt and even mistrust with which one often collects and examines such data.

The objection to the method of psychoanalysis is that the instruction given to the patient to speak out everything that comes into his mind, gives a mass of data which contains not only what is below but what is above the threshold and farther that in applying this method no systematic effort is made, as in the case of the image method, to separate out and classify such data.

Taken all in all, it seems to me, the results show that the image method offers a mode of penetrating below the threshold of consciousness which is at least comparable if not superior to that offered by other methods.

EMOTIONAL POETRY AND THE PREFERENCE JUDGMENT

BY JUNE E. DOWNEY

The University of Wyoming

In a former study¹ the writer reported somewhat extensive experiments upon the imaginal reaction to poetry and the influence of the various forms of the image upon the affective and the æsthetic judgment. The poetic fragments utilized in this experiment were selected largely because of their imaginal suggestiveness. Occasional comments of reagents upon certain fragments indicated that had highly emotional poetry been employed instead of imaginal poetry different results might have been obtained.

Accordingly, a second series of experiments was planned in order to test the emotional factor in poetry. Twenty-four fragments of poetry, somewhat longer than those of the preceding test, chosen because of their emotional content,² were utilized. The judgments obtained are not, however, directly comparable with those given in the preceding series since instead of a grouping of the emotional fragments on the basis of pleasantness-unpleasantness, a grouping of the fragments into eight groups according to preference was asked for. In group 1 were to be placed, according to type-written instructions placed before every reagent, the fragments liked best; in group 8, those liked least; the other fragments in the intermediate groups. After this grouping the reagents were instructed to shade the fragments in each group, placing first in each group the fragment most liked and shading from that to the one liked least. Such an

¹ "The Imaginal Reaction to Poetry," Univ. of Wyom., Department Psychol., Bulletin No. 2.

² That the fragments utilized were actually less imaginal in content than those employed in the previous test is shown by the fact that in proportion to the number of fragments and for the same number of reagents they aroused only half as many images.

arrangement was repeated five times at week-intervals. Each reagent was instructed to record his mood before beginning his grouping and to record it again at the close of the experiment. After the first and the fifth preference arrangement the reagent was instructed to rearrange the fragments, on the basis of the vividness of his emotional reaction to them, in four groups: III. Reaction vivid; II. Reaction moderately vivid; I. Reaction slight; O. No emotional reaction. After the number of each fragment on the second record the reagent was instructed to write a word or phrase descriptive of the emotional content of the fragment. In connection with the second preference arrangement, a rearrangement into four groups as before on the vividness with which the reagent projected himself into the content was asked for, with a complete account of the kind of self-projection observed in any case. With the third preference arrangement a grouping of the fragments with reference to the nature of the inner speech was asked for, together with comments upon the form of the inner speech for each fragment. A fourfold grouping on the basis of the vividness of the concrete imagery aroused by reading was requested in connection with the fourth preference arrangement.

Some four weeks after the last preference arrangement a grouping of the fragments into eight groups according to their beauty was obtained. In group I were placed the most beautiful fragments; in group 8 the least beautiful; in the intermediate groups the other fragments. As before, the fragments were shaded within the groups. In connection with this grouping answers to the following questions were obtained:

1. What do you mean by 'beautiful'? Answer on the basis of your experience while arranging the fragments.
2. In your opinion is an arrangement on the basis of beauty equivalent to an arrangement on the basis of preference? Why?
3. Is an arrangement on the basis of beauty equivalent to one on the basis of pleasantness?
4. Would an arrangement on the basis of pleasantness be equivalent to one on the basis of preference?

5. What kind of emotional appeal do you prefer in poetry? Can you give any reason for your preference?

6. What kind of emotional appeal do you consider most beautiful? Why?

Seven reagents took part in the experiment; all had had considerable practise in introspective work.

A brief description of the poetic fragments employed seems necessary. The descriptive terms used are taken from those given by the reagents in connection with the two groupings of the fragments made by them on the basis of their emotional vividness. An estimate of the emotional value of each fragment was obtained by adding the numbers of the groups in which a particular fragment was placed by each of the seven reagents for each of the two groupings. The greatest sum obtainable was 42; the least, 0. The sum actually received is given for each fragment in parenthesis after the descriptive summary.

The fragments were as follows: 1, twelve lines, from Browning's 'Saul,' expressive of the joys of living, beginning, 'Oh, our manhood's prime vigor!' (28); 2, nine lines, verse XCII., Canto Third, Byron's 'Childe Harold,' descriptive of the exultation and awe aroused by a mountain storm (33); 3, nine lines, verse XXI. of Shelley's 'Adonais,' expressive of inevitability, futility, grief (20); 4, twelve lines, a lyric expressive of companionship (31); 5, sixteen lines, the eleventh verse of Swinburne's 'The Garden of Proserpine,' with an emotional toning of desire for death, annihilation (17); 6, ten lines from Shelley's 'Prometheus Unbound,' expressive of defiance, beginning 'Fiend I defy thee' (29); 7, fifteen lines from Browning's 'Andrea Del Sarto' beginning 'A common greyness silvers everything,' lines that voice a twilight mood of sadness and resignation (28); 8, ten lines, a translation by Symons of one of Mallarmé's exquisite word-pictures, expressing vague aspiration, calm (13); 9, nine lines, fifth stanza of Swinburne's 'A Forsaken Garden,' expressive of barrenness, weariness (19); 10, eight lines, Stevenson's 'Under the wide and starry sky,' completion (23); 11, twelve lines, fifth stanza of Browning's 'Love Among the Ruins,'

descriptive of expectancy and love (25); 12, fifteen lines, from Tennyson's 'The Princess,' 'Tears idle tears' (27); 13, eight lines, Galsworthy's gay wind-song, 'Wind, wind—heather gypsy' (25); 14, eight lines, Blake's 'When the voices of children are heard on the green,' expressive of quiet happiness (17); 15, twelve lines, Henley's famous 'Captain of my soul' verses (34); 16, thirteen lines, first two stanzas of Poe's 'To One in Paradise,' voicing despair (27); 17, sixteen lines, a descriptive piece by Galsworthy, 'We'll hear the unaccompanied murmur of the swell,' expressive of 'God's own quietude of things' (24); 18, seven lines, Yeats' 'Be you still, be you still, trembling heart,' voicing mystical courage (14); 19, eleven lines from Tennyson's 'Lotus-Eaters,' beginning 'There is sweet music here that softer falls,' word-pictures suggesting peace (31); 20, twelve lines, Marston's 'All my roses are dead in my Garden,' expressing despoilment, hopelessness (27); 21, fifteen lines, the hunger for pursuit (16); 22, twelve lines, Yeats' mystical 'Outworn heart, in a time outworn' (14); 23, nine lines, the first two and the last stanza of Moody's 'Heart's Wild-Flower' (33); 24, fourteen lines, Moody's 'Grey drizzling mists the moorlands drape' (23). These fragments were typewritten on separate sheets of paper, convenient for handling. The poet's name did not appear on the fragment and only a few cases of recognition occurred. The fragments, except 4 and 21, were of accepted literary excellence, many of them being classic productions.

On the basis of the data gathered the following points may be discussed: I. The variability and character of the group preference judgment and its dependence upon such factors as the emotional content, self-projection, concrete imagery, the waxing and waning value of the separate fragments; II. The variability and character of the individual preference judgment and its dependence upon peculiarities in the individual reactions; III. The relation of the preference judgment to the judgment of beauty.

I. THE GROUP PREFERENCE JUDGMENT

The average position of each fragment for each of the five arrangements by the seven reagents was calculated with the average M.V. for each arrangement. There is a decrease in the average M.V. from the first to the fifth trial, although not a constant decrease, as follows: first trial, 4.839; second trial, 4.535; third trial, 4.783; fourth trial, 4.629; fifth trial, 4.166. The average M.V. for the first arrangement is somewhat high, although not higher than that given in certain other reports on the subjective judgment. It is, relatively to the number of possible positions, higher than the average M.V. in a first arrangement of imaginal poetry on the basis of pleasantness-unpleasantness. It is tempting to attribute this increased M.V. to the emotional nature of the poetry and very probably it should be so attributed. But it should not be forgotten that increased subjectivity is not the only possible cause of increased variability.

With repetition of the arrangements there is lowered variability. There was at first, as has been pointed out by other investigators of the subjective judgment, a greater agreement on the unpreferred fragments with a shift in the last three trials to greater agreement on the preferred fragments. The average M.V. of the fragments in the first six positions for the five different arrangements is as follows: first trial, 4.01; second trial, 4.62; third, 4.04; fourth, 4.22; fifth, 3.27. The greatest agreement is seen to occur on the fifth trial. The average M.V. for the fragments in the last six positions should also be noticed: first trial, 3.77; second, 3.94; third, 4.53; fourth, 4.52; fifth, 4.41. The difference between the M.V.'s for the first and the last six positions is greater for the fifth than for any other trial.

The increasing agreement of the group with repetition of the test is shown by the extent to which every arrangement is correlated with every other arrangement as given in Table I. The progressive increase in coefficient values for successive arrangements is evident, reaching a final value of .89 for the last two trials.

TABLE I
CORRELATIONS BETWEEN GROUP-ARRANGEMENTS.

Trial	I	II	III	IV	V
I.....		.758	.764	.739	.773
II.....	.758		.750	.699	.820
III.....	.764	.750		.820	.863
IV.....	.739	.699	.820		.890
V.....	.773	.820	.863	.890	
Av.....	.758	.757	.799	.787	.837

Study of the records suggests no explanation for this other than growing objectivity of judgment with increased familiarity with material. With such familiarity the individual judgment would seem to be steadied by social standards.

TABLE II
EFFECT UPON PREFERENCE OF VIVIDNESS OF EMOTION, SELF-PROJECTION, AND IMAGERY
(COMBINED RECORDS. 7 REAGENTS).

	1	2	3	4	5	6	7	8	Totals
III									
Emotion—1.....	16	9	10	5	4	2	5	2	53
Self-projection....	25	9	6	3	2	2	1	4	52
Imagery.....	19	8	11	3	5	0	2	5	53
Emotion—2.....	13	7	7	1	5	2	1	7	43
Total.....									201
II									
Emotion—1.....	9	12	8	7	5	6	3	3	53
Self-projection....	5	6	4	5	3	7	4	3	37
Imagery.....	3	5	4	7	5	3	4	6	37
Emotion—2.....	9	10	7	7	1	5	3	4	46
Total.....									173
I									
Emotion—1.....	3	4	2	7	2	7	7	4	36
Self-projection....	0	4	4	3	7	3	3	6	30
Imagery.....	3	4	3	2	2	4	8	5	31
Emotion—2.....	2	10	5	6	5	5	9	5	47
Total.....									144
0									
Emotion—1.....	0	1	1	2	7	1	3	9	24
Self-projection....	3	7	6	6	4	7	7	9	49
Imagery.....	3	10	8	5	5	9	5	2	47
Emotion—2.....	2	3	4	6	4	5	4	4	32
Total.....									152

An attempt was made to determine the influence of various factors upon the preference judgment by obtaining as described above a four-fold grouping, twice for vividness of

emotional toning and once each for vividness of concrete imagery and of self-projection,¹ and distributing these judgments under the eight preference groups (Table II.).

From this table it is evident that the three factors are about equally potent but that, in general, rich content, emotional, imaginal, and self-projective, contributed to preference. The figures for the second grouping of the fragments on the emotional basis (fifth preference arrangement) indicate some loss of emotional vividness with repetition.

TABLE III

No. of Frag- ments	Five Preference- Arrangements			Arrangement for Beauty			Emotion 1	Self- Proj.	Imagery	Emotion 2	Emotional Tone
	Position	Av.	M. V.	Position	Av.	M. V.					
19	1	5.20	3.20	1	1.85	.98	17	15	20	14	Peace.
23	2	6.08	2.38	3	5.42	2.03	17	15	15	16	Heart's wild flower.
2	3	7.45	2.86	5	6.57	4.65	18	13	19	15	Exultation.
17	4	8.05	2.56	2	4.57	2.94	13	15	15	11	Quietude, companionship.
4	5	8.74	3.44	10	11.28	5.31	18	9	10	13	"You."
11	6	9.42	2.54	6	6.71	3.10	10	12	13	15	"Love among the Ruins."
7	7	9.60	5.20	4	6.57	2.49	12	15	16	16	Twilight: regret.
15	8	9.82	3.00	12	14.00	3.71	19	9	6	15	Fortitude.
1	9	9.85	4.68	7	7.42	1.51	16	12	12	12	Joy of living.
24	10	12.50	4.67	14	14.57	4.04	13	9	15	10	Weariness; greyness.
12	11	12.85	2.96	8	9.71	3.75	15	11	7	12	"Days that are no more."
22	12	12.91	3.15	11	11.71	2.32	10	6	9	10	Mystical rebirth.
10	13	13.42	4.66	17	16.42	5.35	13	12	13	10	"Glad did I live, gladly die."
16	14	13.51	2.35	13	14.42	3.63	14	10	6	14	Despair.
20	15	14.48	4.55	18	16.71	6.33	16	12	13	11	Hopelessness.
8	16	15.17	1.62	9	10.42	5.46	6	6	11	7	Aspiration.
18	17	15.40	3.20	15	15.57	4.20	7	5	3	7	Mystical courage.
5	18	15.42	2.63	21	17.57	3.46	7	7	4	10	Eternal sleep.
13	19	15.54	6.00	22	18.71	3.55	12	12	12	13	Irresponsibility.
14	20	15.63	3.07	23	18.57	2.08	8	13	9	9	Content.
3	21	15.80	3.54	19	16.85	4.45	12	6	4	12	Futility; grief
9	22	16.48	3.10	16	16.14	4.12	12	11	9	7	Barrenness.
21	23	17.82	3.42	20	17.14	5.22	9	9	12	7	Pursuit.
6	24	18.77	3.73	24	21.00	2.00	13	16	11	16	Defiance.

Table III. gives the position, average and M.V. for every fragment, for five preference arrangements, and for the one arrangement on the basis of beauty, together with numbers representing the vividness of the emotional, self-projective, and imaginal reactions, obtained by adding together the

¹ By self-projection is meant an explicit self-reference in whatever form. Cf. "Literary-Self Projection, *PSYCHOL. REV.*, 19, 299-311 (1912).

number of the groups in which the fragment was placed by the seven reagents. An attempt is also made to describe the emotional tone of each fragment. This table confirms the conclusion that rich content contributes to preference but suggests also that imaginal content is slightly more potent in determining preference than are the other factors studied. This is shown also by grouping together the six fragments that the records show to be most emotional, most conducive to self-projection, and most imaginal with an indication of the position of each fragment in the preference series (Table IV.).

TABLE IV

Most Emotional 1	Position	Most Emotional 2	Position	Most Self-Projective	Position	Most Imaginal	Position
15	8	{ 6	24	6	24	19	1
{ 2	3	{ 7	7	{ 7	7	2	3
{ 4	5	{ 23	2	{ 17	4	7	7
{ 19	1	{ 2	3	{ 23	2	{ 23	2
{ 23	2	{ 15	8	{ 19	1	{ 17	4
{ 1	9	{ 11	6	{ 14	20	{ 24	10
{ 20	15			{ 2	3		

The two fragments most definitely imaginal (19 and 2) rank respectively first and third. Many fragments occur in two or more of the groups.

Putting the matter in another way we see that of the six fragments most preferred 19 and 23 are imaginal, favor self-projection, and are emotionally toned; 2 is imaginal and emotional; 17 is imaginal, and induces self-projection; 4 is emotional; 11 is emotional, imaginal, and favors self-projection.

A comparison of the orders received by the different fragments for the successive arrangements indicates that fragments 17, 11, 7, 24, 10, 8, and 22 (slightly) waxed in value; fragments 1, 16, 20, 13, 14, and 4 (slightly) waned in value; fragments 19, 23, 3, 9, 21, 6, 2, 12, 15 remained relatively static; fragment 18 waxed in value and then fell; 5 waned and then waxed in value. Reference to the waxing and waning value of the fragments will occur later in discussion of the arrangement on the basis of beauty.

II. THE INDIVIDUAL PREFERENCE JUDGMENT

The effect of the individual reactions upon the preference judgment was evident and makes necessary a summary statement of certain characteristics of the reagents. There were seven of these reagents as stated before. The conclusions, relatively to their general reactions, are based upon extensive acquaintance with the observers in psychological experimentation.

With reference to imaginal tendencies the observers fell into three groups.

The first group includes reagents Rgr and Ele, subjects in whom there is a strong preponderance of visual imagery. Rgr's visual images are vivid and detailed. Ele shows a strong inclination to emphasize form; she is accustomed to changing all sounds into visual forms. Voices she pictures in series of waves and lines at different levels; she compares different pitches by reference to the heights at which the translating lines are placed. She has a great liking for mathematics.

The second group includes Jan, Hne, and Jdo. These subjects show mixed imagery. Although they employ visual imagery to some extent, they appear to be much more dependent upon kinæsthetic and organic material. Auditory content is, however, very potent for Hne.

The third group includes Ado and Tbu, who are strikingly deficient in visual imagery, an incapacity which in Tbu's case is evidently conditioned by very poor eyesight. Tbu relies almost wholly upon inner speech and is strongly inclined to accept the imageless thought proposition. Ado makes much use of kinæsthetic material and in this respect might more properly be classed with the second group.

The form which self-projection assumed was also somewhat characteristic within the same groups.

For Rgr and Ele such self-reference appeared to be highly objective. Rgr projects herself visually within the scene but without dramatic or kinæsthetic participation in the scene. Ele is "there" as a spectator only. She assumes, without visualization of self, a definite orientation toward the

scene, always on the outskirts, where she is able to get a good view of the situation.

For Hne and Ado, the self-reference is highly colored. Hne gives a visual self-projection that is fused with kinæsthetic and organic material; she is within the scene. Ado is also within the scene, part of it, but without visualization of self. Her participation is definitely dramatic, emotional. These two reagents "subjectify" the poetic material.

Jan and Jdo identify themselves kinæsthetically or organically with persons or inanimate objects described. Sometimes for Jdo there is a projection of kinæsthesia into a visualized figure, not of self. As distinguished from Hne and Ado, these reagents appear to project or objectify the subjective reaction.

Tbu reports little self-reference except that in inner speech he is at once speaker and listener.

A grouping on the basis of the inner speech effects some changes in the distribution of subjects. This inner speech is auditory for Hne, Tbu, Jdo, Ado, and Rgr. But of these reagents Hne is the only one who heard, to any extent, fragments read in voices other than her own. Tbu, Ado, and Jdo make much of inner elocution, and Tbu is almost wholly preoccupied with this aspect of the reaction.

Ele and Jan were sceptical as to auditory content for their inner speech. Ele reported again curious translations of the inner speech into visual forms.

The average (with M.V.) was calculated for each fragment for the five arrangements by each reagent and the position assigned each fragment on the basis of this average. The average M.V. for each reagent from the average of his five arrangements was calculated and gives us an indication of his individual variability. His average M.V. from the average group judgment was also determined and this indicates the extent to which his judgment was representative of the group.

The variability of each reagent from his own average for the five trials was as follows in the order of least variability: (1) Tbu, 2.21; (2) Rgr, 2.28; (3) Ado, 2.71; (4) Ele, 3.11;

(5) Jdo, 3.71; (6) Jan, 3.56; (7) Hne, 4.09. Increased variability seems, in general, to characterize the more emotional reagents (determined by their fourfold grouping of the fragments), while the effect of the emotional material in increasing the variability is shown by comparison of the individual variability in this test with that found when less emotional poetry was utilized; it is proportionately much higher in the present test.¹

The average variability of each reagent from the average of the seven reagents for the five arrangements gave the following order: (1) Jdo, 2.75; (2) Ado, 2.90; (3) Rgr, 2.96; Ele, 3.07; (5) Jan, 3.48; (6) Hne, 3.78; (7) Tbu, 5.19. The most interesting point in this listing of reagents is Tbu's shift in position, which with high personal consistency indicates a different basis of judgment from that of the other reagents, explanation for which is to be found in his introspective reports. On the whole, it may be noted, the variability from the group average is no more extensive than that found in imaginal poetry.

TABLE V
PREFERRED FRAGMENTS

	Rgr	Ele	Hne	Jan	Ado	Jdo	Tbu
1	19	17	11	4	19	19	15
2	2	23	4	13	17	23	1
3	7	19	12	23	7	7	2
4	23	2	19	19	23	17	10
5	1	7	1	18	2	10	24
6	4	24	13	17	11	4	5

An arrangement in order of the six fragments which were most preferred by each of the reagents shows at once the effect of the individual differences in reaction (Table V.). We note that of Rgr's preferred fragments, the first four are exactly in the order of imaginal vividness, largely visual. Rgr states very definitely that she prefers poetry which calls up vivid visual images, unless, as in fragments 13, such images are grotesque. Ele's six preferred fragments are just the six

¹ A great variability from her own average in the judgments on emotional poetry in contrast to great self-consistency in judgments on imaginal poetry was shown very definitely by the one reagent (Jdo) who participated in both tests.

most imaginal fragments, although not in the exact order of the group. Ele also expresses a preference for poetry conveying the clearest imagery and is particularly pleased with what she calls sound-pictures.

Hne's preferred fragments are chiefly emotional in tone; 11 and 4, both highly emotional, represent her first and second choice. Jan's preferred fragment is 4, which is emotional in its appeal, but his other choices give some indication of dependence upon imaginal richness. He also prefers 18, a mystic fragment of little sensuous content. Ado's and Jdo's preferred fragments show the influence of imaginal content as well as of emotional toning.

Tbu's preferences are distinctly individual, determined largely by the kind of emotion expressed which Tbu prefers to be strong in nature, expressive of a desire to act, to conquer. Neither 19 nor 23, so generally preferred by other reagents, occur among his first six fragments; the absence of imaginal fragment is very evident.

TABLE VI

CORRELATIONS OF AV. REFERENCE ARRANGEMENT OF EACH REAGENT WITH THAT OF EVERY OTHER REAGENT

Reagent	Rgr	Ele	Jdo	Jan	Hne	Ado	Tbu
Rgr . . . .		.601	.590	.461	.232	.700	.237
Ele . . . . .	.601		.410	.325	.209	.702	.103
Jdo . . . . .	.590	.410		.536	.230	.569	.200
Jan . . . . .	.461	.325	.536		.256	.241	-.272
Hne . . . . .	.232	.209	.230	.256		.381	-.059
Ado . . . . .	.700	.702	.569	.241	.381		.193
Tbu . . . . .	.237	.103	.200	-.272	-.059	.193	

The tabulation of preferences suggested the working out of the coefficients of correlation for the average preference arrangement of each reagent with every other. These are given in Table VI. It is evident from this table that reactions on the basis of imaginal qualities are most representative (Rgr, Ado, Jdo, Ele) and that the subject most visual in reaction (Rgr) gives the highest average correlation. Should such a conclusion be substantiated by a more extensive investigation it would seem to throw light upon the kind of

literary material that would probably have constant value for a long period of time and the type of critic that would best represent the average reaction in the long run.

Certain other factors influencing the individual reactions are evident from the tables and the introspective reports. Table III. indicates that subdued emotions are more generally preferred by this group than are violent emotions. The individual reports confirm this, although the effect of the mood of the day is mentioned by several reagents as influencing their preferences.

Rgr. "In poetry the emotional appeal which I prefer depends largely on my mood.—I like poems about nature as they arouse emotions outside of one's self."

Ele. "An appeal to quiet, drowsy, lesiurely, reminiscential feelings suits me best.—I do not like noise, boisterousness, confusion."

Hne. "The appeal preferred depends upon the mood. Usually prefer something expressing longing unfulfilled, or the joy of living."

Jan. "I do not know that I can select any one emotional appeal; sometimes it's one sort, sometimes another. Pathos perhaps makes the greatest appeal."

Jdo. "I prefer the emotional tone to be in harmony with my mood which varies strongly from day to day. In general I prefer a sad toning."

Ado. "I like an emotional appeal that is melancholy in tone."

Tbu. "I prefer a strong emotional appeal to any of the pleasant emotions and sometimes to those generally considered unpleasant. Usually, however, I prefer such an appeal to emotions as are aroused by fragments 1 and 15, feelings of desire to act, conquer, oppose even unconquerable forces. The reason for this preference so far as I can judge is that such emotions are not common in me. However much I may consider them ideal, I do not possess them. It is their contrary nature that appeals to me."

In order to test specifically the effect of the mood of the day upon the reaction to strongly emotional poetry, the

following tabulation was made (Table VII.). The seven fragments most melancholy in tone were selected, 3, 5, 9, 12, 16, 20, 24; three of happy buoyant coloring were chosen, 13, 14, 1; and three of strong aggressive emotion, 2, 6, 15. Next, record was made from the introspective notes of any cases where the reagent reported strongly depressive moods at the time of the experiment. Eight cases of this occurred. The effect of the mood-dominance was then determined by subtracting the position on the day in question for the given fragment and the given reagent from the average for that reagent's five arrangements. A minus sign indicates increased preference for the fragment for the given day; a plus sign indicates decreased preference.

The table would seem to suggest some interesting differences between the reagents as to the effect of mood upon their preferences. Jan and Jdo show very evidently that a mood of depression increased for them the preference for melancholy poetry and in Jdo's case very considerably lowered the liking for buoyant fragments. The effect of the mood upon fragments 2, 6, 15 is less constant. Ado's record indicates a general lowering of values under depression, with, in a few cases, added appreciation of the melancholy fragments. Rgr shows less effect of mood upon preference than any other reagent, and that effect is mainly a lowering of values. The effect of depression is somewhat variable for Ele and Hne, both records suggest that harmony with the mood is likely to increase preference. Under the influence of the given mood these reagents show inclination to stress 2 and 6. The effect of mood upon the emotional reaction is a very important one. The above discussion, however meager, suggests a method by which the problem may be attacked.

Jdo's comments on the effect of mood upon the reaction for any particular day are more complete than those of the other reagents and in certain respects instructive. There were days of æsthetic toning and other times when it required considerable effort to surrender to poetic suggestion. These differences were due to general mental conditions, rather

than to experimental conditions. At the close of the experiment Jdo was usually in a more æsthetic mood than at its beginning. The most adverse general criticism upon experimental investigations of this sort she finds in the reduction of the time needed for æsthetic absorption. Short fragments suffer in comparison with the longer productions from which they are taken. Fragment 12, for instance, frequently failed 'to catch fire.' Rereading was necessary. Again, Jdo noted that the first fragments suffered by being read before she had assumed a poetic mood; or, at times of increased susceptibility to outer suggestion, fragments 1 and 2 set the tone for subsequent reactions.

The second arrangement was made under a mood of great depression, heightened by the 'grey toning' of the weather. Jdo recorded in her notes that fragments expressive of sadness and futility were given a higher value than before. She was aware also of a tendency to react against the mood by assigning high value to fragments expressive of fortitude. At the third arrangement a mood of æsthetic sadness again enhanced the value of fragments of melancholy tone. On this occasion the lilt and swift mocking rhythm of 9, 14, and 13 were found very distressing. She reports, "They move too rapidly and lightly to fit in with the tempo of my mood." At the close of the test the pulse-rapidity was found to be 78. The fourth arrangement was made when the subject was in a scientific mood that contrasted strongly with the æsthetic mood of the previous week; there was restlessness present and distaste for taking time for the experiment. The melancholy-toned fragments were conspicuously less pleasing than before. Fragments 13 and 14 now fitted into the rhythm of the day and were shifted from the eighth to the second group. The pulse was 90. The fifth arrangement was made under the influence of a "hurry-mood" (pulse 94); Fragment 13 was felt to express exactly the personal tempo for the day.

Besides investigating the influence of the imaginal and emotional reactions upon preference, the experimenter made an attempt to determine the effect upon preference of the different forms of the inner speech. In particular, an effort

was made to determine whether certain fragments encouraged an auditory inner speech and others stressed the kinæsthetic quality of inner speech. To this end the reagents were requested, in connection with the third preference arrangement, to place, if possible, the fragments in two groups, one group being for fragments in which the auditory aspect was the more pronounced in the inner speech, the other for fragments that stressed the kinæsthetic factor. The attempt

TABLE VII
EFFECT OF MOOD ON PREFERENCE

Mood Reagent	Arrangement							
	1st Dis- gusted Jan	1st De- pressed Ado	3d "Blue" Ado	2d Sad Jdo	3d De- pressed Jdo	3d Dis- satisfied Rgr	4th Im- patient Ele	5th Dis- heart- ened Hne
No. of Frag.								
3. Futility Grief.....	- 6.2	+6.8	-9.2	- 4.6	- 3.6	-4.2	+ 1.2	+ 5.4
5. Eternal Sleep.....	-10.8	+4	-6.0	- 6.2	- 3.2	0.0	- 3.2	- 2.8
9. Barrenness.....	- 3.8	-1.6	+1.4	- 7.8	+ 2.2	-4.4	- 1.0	- 4.4
12. "Days that are no more".....	+ 1.6	+3.8	+1.8	- 1.0	- 5.0	+3.0	- 9.6	- 3.0
16. Despair.....	- 3.2	-1.8	+2.2	+ 2.4	- 3.6	+1.4	+ 0.6	+ 1.8
20. Hopelessness.....	- 8.8	-0.2	-6.2	+ 1.4	- 3.6	+2.0	+ 4.2	+ 0.8
24. Weariness.....	- 1.2	+2.2	+5.2	-11.6	- 0.6	+3.4	- 1.6	+ 1.8
13. Gayety.....	- 3.2	+0.8	-1.2	+ 2.6	+11.6	-0.4	+ 3.2	+ 6.0
14. Happiness.....	- 4.2	-0.8	+0.2	+ 3.0	+ 9.0	+2.8	- 2.8	+ 0.8
1. Joy of living.....	+ 8.2	+1.8	-0.2	+ 5.6	+ 6.6	0.0	- 3.2	+12.2
2. Exultation.....	- 0.6	+1.6	+4.2	+ 8.6	- 2.4	0.0	- 3.2	-10.4
6. Defiance.....	+ 2.6	+1.6	+1.6	- 2.8	- 3.8	-0.2	-15.0	- 8.0
15. Fortitude.....	- 5.8	+6.4	-4.6	- 8.0	+ 2.0	-0.6	+ 0.2	+ 2.0

proved abortive, although the comments upon the variations of the inner speech were instructive. Only two reagents (Tbu and Jdo) were willing to attempt the grouping suggested. Tbu's choice of fragments in which the auditory side was most stressed was as follows: 5, 8, 9, 10, 12, 13, 14, 16, 19, 20, 21. Jdo's selection was as follows: 4, 10, 12, 13, 14, 19. There are five fragments selected by both of these reagents.

Fragment 21 was written in dialogue form, the two speakers being a mother and son. Nearly all the reagents note a difference in inner speech with the transition from one part to another. Hne hears her own voice for the

mother's part, and a man's deep voice for the son's. She finds the fragment pleasing. Tbu, on the other hand, who hears the man's voice in his own, and the mother's voice in a squeaky disagreeable voice, does not like the fragment.

Ele reported that she seemed to see the inner speech. "Inflections are represented by different levels upon a scale." For Jdo, there was a prominence of the visual verbal side (with subordination of the inner speech) for fragments 4, 9, 13, and 17. These two subjects are the only ones referring to visual factors in connection with the inner speech.

III. THE PREFERENCE JUDGMENT AND THE JUDGMENT OF BEAUTY

The introspective reports of the reagents, except those of Tbu and Hne, do not indicate much difference in their basis of judgment when they shift from the category of preference to that of beauty. Ele and Rgr assert that there is no difference introspectively between the two forms of judgment. Rgr adds, "I would not prefer those fragments which did not appeal to me as beautiful." Jdo makes the preferred fragments largely correspondent with the beautiful ones although she reports that there may be poetry which is merely pleasing and preferred for that reason. Ado finds little difference between the two categories, except that in a preference arrangement she gives more attention to the thought and in the beauty arrangement more attention to style and form of expression. Hne reports considerable difference between the two kinds of arrangement. She also emphasizes the expression-side as important for the judgment of beauty and the thought-side as important for preference. Tbu makes the following distinction, "By beautiful I mean a fragment that is pleasing in rhythm, rhyme, and meaning. Preference is based on the emotional reaction."

Some differences are given as to the emotional appeal that seems most beautiful in comparison with that which is preferred. Ele, Rgr, and Ado find no difference. Ele states that an appeal to quiet drowsy emotions is at once most preferred and most beautiful; Rgr finds an appeal to peaceful

emotions most beautiful; so, too, does Jan. Jdo writes, "I feel the appeal to renunciation, to world-sadness, to wistfulness, to serenity most beautiful." And Tbu, "A lack of emotional appeal seems most beautiful to me; something calm, quiet, not at all exciting." Throughout the group there is evident a tendency to reduce the value of personal emotion as a factor in the judgment of beauty.¹

Correlation of the average arrangement by the seven reagents on the basis of beauty with the average on the basis of preference (five trials) is, however, very high, .894. A correlation of this average judgment for beauty with the average of the first and the fifth preference arrangement gives as coefficients .729 and .941 respectively. This last coefficient may indicate merely that the growing agreement of the group shown in the correlation of successive arrangements for preference (Table I.) continued in spite of the shift in category and the lapse of four weeks; or, more probably, it shows that with familiarity with the fragments preference is determined more definitely by the element of beauty than is evident in the earlier trials. A preliminary arrangement for beauty would have been most valuable in this connection.

The average M.V. for the arrangement on the basis of beauty is 3.61, a lower M.V. than found for any of the five preference arrangements. This lowered M.V. suggests a more objective standard for the judgment of beauty than for a judgment of preference.² Tbu, in particular, shifts his basis of judgment. The correlation coefficient for his arrangement on the basis of beauty with the average of the group is high, .783.

In particular, it seems probable that a beautiful fragment is more constant in its value than a preferred one and falls less in value with familiarity in the repeated arrangements. There are several ways in which one may test this assumption. One may, for instance, inspect the order of fragments in the first preference arrangement (group average) and note which fragments show striking discrepancies with the order of

¹ This report is quite in accord with Souriau's conclusion. "La Reverie Esthetique," p. 104 f.

² Compare Müller-Freienfels, R. "Psychologie der Kunst," II., p. 171.

fragments in the arrangement for beauty (group average) One might then check this list with the numbers of those fragments that have already been cited as showing evidence of a waxing, waning, or static value in the repeated preference arrangements. Following this out, we find that fragments 4, 13, 14, 15, 16 and 20 give a much higher value (five or more places) in the first preference arrangement than in the arrangement for beauty. With one exception (15) these are just the fragments which were found to fall in value with the repeated arrangements. Fragments 7, 8, 9, 12, and 17 show a much higher value in the arrangement for beauty than in arrangement for preference. Three of these fragments 7, 8, and 17 were fragments that waxed in value with the repeated arrangements. The outstanding fragments are instructive. Fragment 15 is very definitely a preferred fragment rather than a beautiful one; fragments 9 and 12 are judged to be beautiful but in spite of that are not highly preferred.

Again, taking the average arrangement for beauty and dividing it into two sections, the twelve fragments least and the twelve fragments most beautiful, we find that of the twelve most beautiful fragments, five were those which waxed in value in the preference arrangements, five were static in value, two waned in value. Of the twelve less beautiful fragments, three fell in value in the preference arrangements, five were static, two waxed, two (18 and 5) fluctuated.

The conclusion seems justified that the beautiful has a value which holds its own or waxes with familiarity.¹

IV. SUMMARY AND CONCLUSIONS

As a general outcome of the experiment we conclude that the group reaction to emotional poetry is slightly more subjective than the group reaction to imaginal poetry. Familiarity with the material reduces the group variability. Rich content, emotional and imaginal, is shown to contribute to preference, with a slight advantage in favor of imaginal content as a determining factor. Certain fragments appear

¹ Müller-Freienfels, *op. cit.*, II, p. 168.

to fall in value with repetition of the judgment; others to increase; others are static.

The effect of individual differences upon preference is so evident that a grouping of the reagents on the basis of type of reaction is instructive. The more emotional subjects appear to be more variable in their judgments. The preferences of four of the reagents show a great dependence upon imaginal content; emotional vividness is potent for two subjects; and kind of emotional content for one. The intercorrelations indicate that preferences based on imaginal content have a more representative value than preferences determined by emotional content. The latter are influenced by the mood present at the time of choice.

A group arrangement on the basis of beauty correlates very highly with the average group preference arrangement and would seem to be, for most of the observers, determined in much the same way. This second judgment is, however, less subjective than the preference judgment. Apparently the more beautiful fragments have a more constant value than fragments that are merely preferred. Since the former do not wane in value as do the latter, in time the two categories closely approximate each other.

In general, the order of merit method, in conjunction with an analysis of individual reports, appears to afford a most excellent means of studying the æsthetic reaction.

AN EXPERIMENT IN ASSOCIATION

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THE method used in this experiment was devised by Dr. J. E. Lough, of New York University. It is simple and easy to execute, and at the same time it is very effective. The experiment is dominantly mental in character.

1. AIM

This experiment was studied in the light of the influence of (a) practise, and (b) such transient factors as distraction, fatigue, concentration, state of health, etc.

2. METHOD AND MEANS

The experiment was conducted individually, the writer being the subject. The means used were the test and key sheets of the Lough Association Method. Other means were a common lead No. 2 pencil and paper to write the associated letters on. Time was kept by an ordinary watch.

The test sheet contained ten rows of letters; each row contained twenty letters. These letters were in non-alphabetic order. The key sheet had two rows of letters on it, one just above the other. The top row was in alphabetic order, from A to T, inclusive. The bottom row was placed in random order and each of its letters was directly under a letter of the top row. For convenience a test sheet and keys have been inserted. On this sheet seven keys are given, the first in full, but as the top row is the same for all keys only the bottom row of each of the others is given.

3. PROCEDURE

This experiment was taken in three divisions. The morning test (A) was taken between seven and eight o'clock, with emphasis on speed, *i. e.*, it was quantitative in nature. The

afternoon test (*B*) was taken between one and two o'clock, and was qualitative in nature, the emphasis being put on the quality of the work rather than speed. The evening test (*C*) was taken for both speed and accuracy and came between ten and eleven o'clock. The general course of these three tests, except the aspects already described, was the same in all.

TEST SHEET

Time

K	C	E	N	O	R	A	F	B	I	L	G	S	M	P	T	D	J	H	Q
M	K	N	G	O	L	C	A	E	B	T	I	F	Q	J	P	H	R	D	S
C	D	A	T	G	I	S	K	R	N	J	M	Q	S	E	H	O	P	L	F
Q	T	C	P	F	J	N	L	I	C	D	R	G	S	A	E	K	H	B	M
T	P	H	M	J	N	L	S	O	F	D	G	E	Q	L	K	A	N	B	I
N	I	B	Q	E	H	D	T	J	R	F	A	K	S	L	O	G	M	C	P
A	Q	I	K	E	G	T	S	J	D	O	H	C	F	M	B	R	L	P	N
S	A	P	J	Q	M	G	D	F	T	R	K	I	N	H	L	E	O	C	B
J	E	I	B	D	N	G	S	O	C	M	L	A	Q	F	R	P	T	K	H
G	N	E	D	K	B	S	R	Q	H	P	C	J	L	T	M	F	A	O	I

KEYS USED

1																			
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
U	Y	T	M	B	J	C	Z	C	L	Y	K	A	E	G	F	I	H	N	D
2																			
T	M	H	I	A	S	C	B	X	D	E	J	F	Y	W	G	O	K	U	L
3																			
S	X	Y	K	N	J	U	P	T	P	E	C	O	Q	R	A	D	E	Z	L
4																			
M	T	J	O	D	P	V	A	Y	C	F	B	S	Q	E	W	G	N	H	M
5																			
Z	U	F	L	Y	M	B	W	Z	E	R	D	H	A	V	J	N	G	I	O
6																			
C	P	G	Q	K	T	A	X	U	N	Y	O	J	F	R	L	W	I	M	D
7																			
F	G	X	J	R	W	V	L	D	M	B	J	J	S	C	Y	I	K	U	Z

Making the associations of the letters was done in the following manner: The key, until all associations were thoroughly committed to memory, was kept just above the line, on the test sheet, on which the subject was working. The letters in each line of the test sheet were taken consecutively as they were approached, regardless of their order. Each one was matched with its likeness in the upper row on the key, and under it was written the particular letter which appeared under its likeness in the top row of the key, *e. g.*, A was first in the top row on the key: suppose that under A in the bottom row of the key was Z, then whenever A was

found in a line on the test sheet Z was written under it. For further illustration take an actual case. On the test sheet K is the first letter in the first line; by running down the top row of letters on the key (No. 1) we find that K has Y under it; therefore we would write Y under K on the test sheet. All the other letters are associated in the same way with the various letters of the alphabet.

These associations were made very slowly at first. The subject, however, soon learned a few of the associations or equivalents, and learned how to make short cuts from the letters on the test sheet to their equivalents in the key, without going to the first of the key and following it letter by letter till the right one was reached as the tendency at first was to do, and thus continually decreased the time for each test. As these associations were committed to memory, this entire process of referring to the key for the equivalent was, of course, syncopated. When the associations became well fixed in consciousness the sight of a certain letter on the test sheet brought up an immediate image of its equivalent in the key and the motor-writing impulse was discharged, resulting in the hand movement executing the writing of the equivalent.

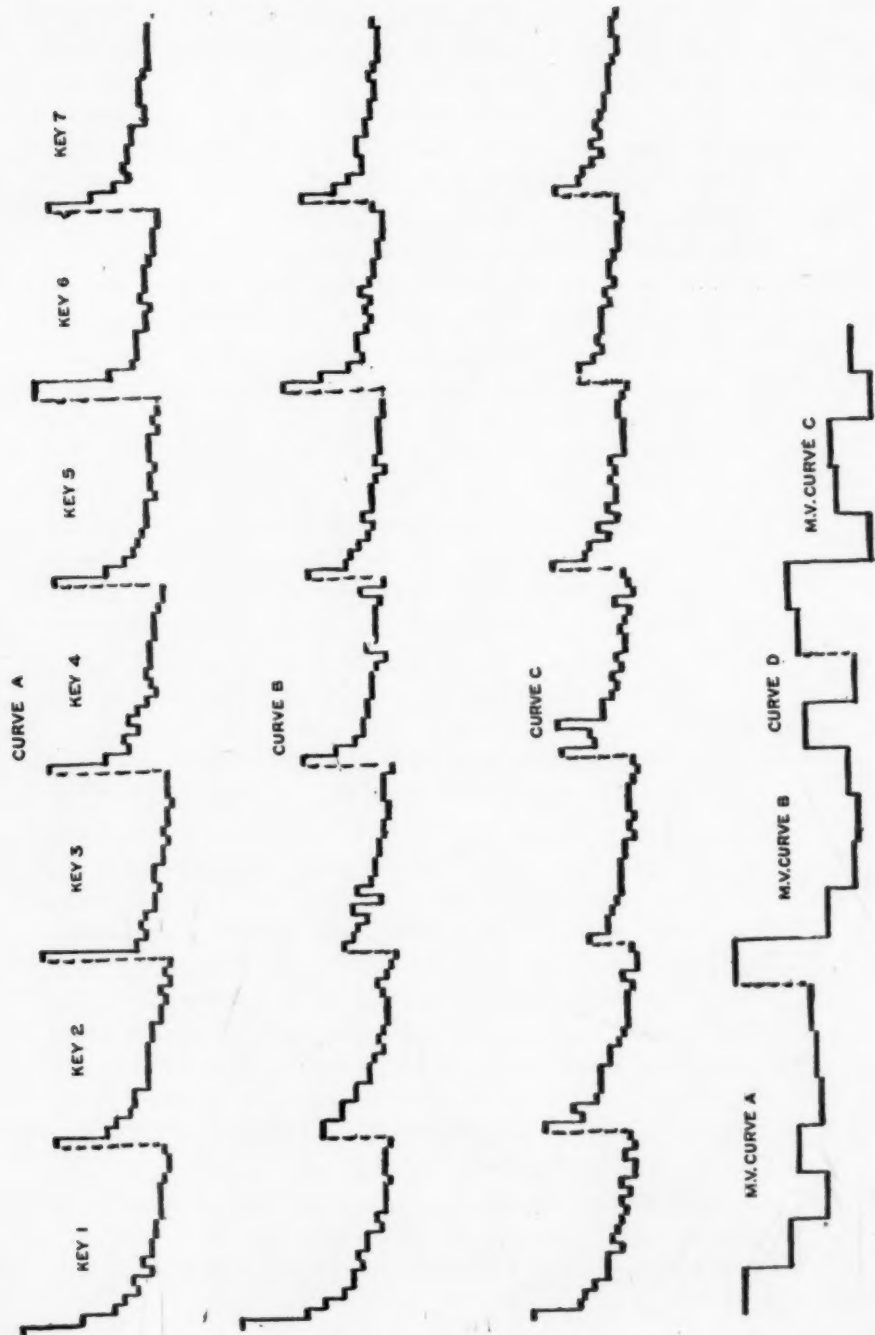
In this experiment the completion of a test sheet consisting of ten lines constituted a test, one of the ten lines constituted a trial.

Twenty tests were made in each key, except the fifth, which by oversight was discontinued after nineteen tests. When one key was finished another was immediately begun. Seven keys were finished, covering a total of one hundred and thirty-nine days. On account of illness one test was missed in both the morning and the evening series. No other break occurred in the entire experiment.

4. RESULTS

The results of this series of tests are very interesting, especially from the standpoint of practise, and the effect of changing keys.

Curves are plotted and tables compiled from the daily



records. These curves and tables show concretely and graphically the learning process or habit formation in this experiment.

The tables show, for each key, the daily record in seconds for the average of ten trials, or one test, the general average, the maximum and minimum trials, and the mean variation for twenty tests.

Curves *A*, *B* and *C* represent the daily series of experiments as heretofore explained. Curve *D* represents the mean variations in the various keys and for the three series. This curve shows that in each succeeding key the mean variation became smaller and smaller.

The subject found that to try to rush either in getting adjusted in order to start at a given time, *e. g.*, when the second hand of the watch reached the thirty seconds mark, or to finish a trial in a shorter period than the previous one nearly always resulted in a loss rather than a gain in time. It seemed that consciousness rebelled against any acts of coercion. Usually when the best records were made the process was almost unconscious, *i. e.*, no special effort for speed was being made.

Some associations in each key were easily made because of their familiarity. That is, they formed initial letters of familiar names and for that reason were easily remembered. After these, the associations of the first and last letters with their equivalents were the easiest to form. The remaining associations then were retained by sheer memory.

At times it was very hard to concentrate the attention, and as a result a very poor record was made. Many times the subject wasted time in trying to recall a certain equivalent instead of looking at once at the key.

In some cases the sequence of letters offered resistance to conscious activity. For instance, in key No. 1 *Y* is the equivalent of both *B* and *K*, and it happens that *B* and *K* come together in the last line of the test sheet, thus causing two *Y*'s to come consecutively in the association. In this case the subject had a feeling when writing the second *Y* that he was either repeating the same association or making

a false association which caused considerable distraction. In key No. 7 the letter J comes twice consecutively; its equivalents are L and M; it happens that in the ninth line of the test sheet the letters M and L come together, thus causing a repetition in the association as explained above.

The subject had another source of distraction closely akin to that mentioned above, namely, making a second association and thus writing the wrong letter. To illustrate this process let us refer to key No. 1; D in the top line has its equivalent M in the bottom line; while M in the top line has its equivalent A in the bottom line; when the key became well memorized there was a tendency, upon seeing D, to run ahead and, instead of writing its equivalent M, to write M's equivalent A. This difficulty may have been due to a lack of concentration of attention.

It was also found that a cold, fatigue or unaccustomed noise, persons entering the room, knocking on the door, etc., caused slow work, or an increase in the time record.

The form of the curves *A*, *B* and *C* is very striking. Each one of these composite curves contains curves of the seven keys used. The broken vertical lines between these curves are merely connections and have nothing to do with the experiment.

It is very significant that in these curves for the various keys the greater part of the gain comes during the first day's practise. For instance, in curve *A*, key No. 1, the total gain was 32.5 seconds, while the gain of the first day was 13 seconds. In key No. 3 of the same curve the total gain was 28 seconds, while the gain for the first day was 20 seconds, thus leaving a gain of only 8 seconds during the remaining nineteen days.

For the most part the key curves in curves *B* and *C* make less gains than those in curve *A*. This is due, however, not so much to a failure in reaching low minima as to the fact that the maxima were lower than those in curve *A*. This was expected because of the practise in the same keys in curve *A*. While the mental attitude was different and while the aim was not identical in the three series, nevertheless, the practise

had the same effect on consciousness and the habit-forming processes; and, therefore, the second and third series had the benefit of the practise done in the first series.

In passing from one key to another, of course there was a considerable rise in time. It has been contended by some authors that such rises in changing the reaction to certain stimuli are caused by interference; others, Bair,¹ for instance, think not, unless it takes longer to do the new test than it did to do the preceding one.

It seems to the writer that there are two possible explanations: first, if the time taken in doing the new experiment is less than that for the old one the initial rise is due simply to the general law of habit formation and not to interference of associations formed in the previous habit. Because if such interference does exist, and this added difficulty plus the normal difficulty in forming any habit be fused together, it would undoubtedly take a longer time to perform the new experiment the first time than it did to perform the old one the first time; and, secondly, it is probable that there is, on account of similarity and recency when two experiments are related in character, a certain amount of interference which would tend to decrease the time. It is also probable that a certain amount of the learning in the first experiment is transferred to the new one which would tend to decrease the time. With one of these forces tending to increase the time and the other tending to decrease it a resultant is obtained which ordinarily gives as a consequence a lower time record than occurred in the former experiment. It seems to the writer, from his study of general experimental findings and from a close study of his own experiments in the learning process, that the latter hypothesis is the more tenable.

5. CONCLUSION

In this experiment we have the typical learning process. This process is made graphic by curves which show very rapid progress at first, but finally the rate becomes very slow.

¹ Bair, J. H., "The Habit Curve," *PSY. REV.*, Monog. Suppl., 1903.

TABLES FOR THE SEVEN KEYS

AVERAGE TIME IN SECONDS FOR EACH TEST OF TEN TRIALS

Key 1

Key 2

Date	A	B	C	Date	A	B	C
Oct. 22.....	45.5	48.5	37.4	Nov. 11.....	38.2	30.9	33.8
" 23.....	33.3	35.2	26.8	" 12.....	26.7	30.5	26.1
" 24.....	26.5	31.3	26.4	" 13.....	25.4	26.6	27.5
" 25.....	24.2	27.4	24.1	" 14.....	22.1	26.9	22.6
" 26.....	21.2	24.7	21.4	" 15.....	20.9	23.8	21.6
" 27.....	21.8	24.5	20.9	" 16.....	21.4	24.4	21.6
" 28.....	18.5	22.8	20.8	" 17.....	21.4	21.4	22.6
" 29.....	20.1	23.7	17.9	" 18.....	17.9	20.7	20.2
" 30.....	17.9	21.5	20.0	" 19.....	18.4	20.1	20.1
" 31.....	17.7	21.7	19.1	" 20.....	17.9	18.5	18.0
Nov. 1.....	17.0	19.1	18.3	" 21.....	17.8	19.3	17.0
" 2.....	16.6	20.1	17.3	" 22.....	17.5	17.7	15.9
" 3.....	15.8	18.1	17.7	" 23.....	16.5	17.0	16.2
" 4.....	16.1	17.7	15.9	" 24.....	16.5	17.4	16.2
" 5.....	16.1	18.3	17.5	" 25.....	14.9	16.5	16.3
" 6.....	15.6	17.0	15.5	" 26.....	14.8	18.4	15.1
" 7.....	15.3	18.1	15.2	" 27.....	14.1	18.8	16.9
" 8.....	14.0	17.6	17.3	" 28.....	14.6	16.9	13.6
" 9.....	14.3	17.6	14.6	" 29.....	13.3	15.9	14.4
" 10.....	14.7	17.6	15.9	" 30.....	14.5	15.4	15.5
Gen. Av.	20.1	23.1	19.8		19.1	20.8	19.6
Maximum.....	55.0	55.0	42.0		45.0	39.0	40.0
Minimum.....	12.0	15.0	13.0		11.0	13.0	12.0
M. V.....	5.18	5.30	3.82		4.19	3.33	4.00

Key 3

Key 4

Dec. 1.....	40.2	25.9	24.0	Dec. 21.....	37.9	33.7	29.0
" 2.....	20.1	24.4	29.2	" 22.....	26.2	26.6	22.2
" 3.....	17.7	23.2	20.4	" 23.....	20.9	23.4	22.6
" 4.....	19.2	21.4	19.3	" 24.....	22.4	21.4	29.6
" 5.....	17.8	23.6	18.1	" 25.....	19.4	21.3	19.8
" 6.....	15.9	18.8	16.9	" 26.....	21.2	20.3	20.4
" 7.....	16.3	22.7	17.6	" 27.....	19.4	19.9	18.0
" 8.....	14.6	19.9	17.3	" 28.....	17.4	18.5	17.1
" 9.....	15.9	18.6	17.0	" 29.....	15.2	18.7	17.6
" 10.....	16.3	19.2	16.3	" 30.....	15.7	19.2	16.5
" 11.....	13.9	17.8	15.5	" 31.....	17.5	17.7	17.2
" 12.....	13.9	17.7	14.4	Jan. 1.....	15.6	15.9	15.3
" 13.....	13.0	16.7	14.5	" 2.....	15.6	19.7	14.9
" 14.....	14.4	16.6	14.1	" 3.....	16.0	16.9	15.7
" 15.....	13.0	15.8	15.4	" 4.....	15.4	18.4	15.1
" 16.....	12.8	16.2	14.6	" 5.....	15.0	18.1	14.3
" 17.....	12.4	17.7	15.0	" 6.....	14.5	18.3	17.1
" 18.....	13.1	16.5	14.1	" 7.....	14.1	16.6	13.2
" 19.....	13.0	16.7	13.4	" 8.....	12.7	20.5	13.7
" 20.....	13.2	15.1	13.7	" 9.....	13.2	16.2	15.3
Gen. Av.....	16.3	19.2	16.6		18.3	20.2	17.8
Maximum.....	57.0	30.0	29.0		42.0	42.0	33.0
Minimum.....	11.0	13.0	12.0		11.0	14.0	12.0
M. V.....	3.36	2.70	2.15		4.06	2.61	2.86

Key 5

Key 6

Date	A	B	C	Date	A	B	C
Jan. 10.....	35.9	31.7	30.1	Jan. 29.....	38.6	36.3	... ²
" 11.....	24.9	23.5	23.3	" 30.....	... ²	28.0	22.9
" 12.....	21.2	22.5	21.6	" 31.....	23.2	22.1	19.6
" 13.....	18.7	20.9	18.4	Feb. 1.....	18.4	18.5	18.2
" 14.....	18.0	19.1	20.5	" 2.....	16.8	20.4	18.6
" 15.....	16.5	18.4	16.2	" 3.....	17.4	19.8	18.3
" 16.....	16.1	20.3	17.7	" 4.....	16.6	18.4	17.5
" 17.....	16.0	17.7	16.3	" 5.....	14.7	16.6	18.1
" 18.....	15.9	17.7	16.4	" 6.....	14.7	18.2	16.0
" 19.....	13.9	17.9	16.7	" 7.....	14.3	17.0	17.2
" 20.....	14.9	16.9	15.9	" 8.....	16.9	19.1	15.0
" 21.....	15.1	15.3	16.8	" 9.....	14.8	16.9	15.8
" 22.....	13.7	17.2	14.0	" 10.....	14.8	16.2	15.5
" 23.....	15.1	16.0	14.1	" 11.....	14.9	15.9	15.3
" 24.....	15.1	16.0	14.1	" 12.....	13.9	14.8	13.8
" 25.....	14.7	15.7	14.7	" 13.....	13.3	14.7	13.5
" 26.....	13.1	16.2	14.9	" 14.....	12.5	13.8	13.8
" 27.....	14.0	14.8	13.6	" 15.....	12.3	14.0	13.0
" 28.....	13.3	15.3	13.3	" 16.....	12.3	13.8	14.4
" 29 ¹				" 17.....	12.3	15.6	13.7
Gen. Av.....	17.1	18.6	17.3		16.3	18.6	16.3
Maximum.....	38.0	40.0	35.0		43.0	40.0	25.0
Minimum.....	11.0	13.0	12.0		11.0	12.0	12.0
M. V.....	3.52	2.80	2.89		3.61	3.74	2.15

Key 7

Feb. 18.....	35.3	31.4	27.4	Mar. 2.....	14.6	15.4	15.2
" 19.....	25.5	23.6	22.1	" 3.....	14.9	16.0	14.5
" 20.....	20.9	21.1	20.9	" 4.....	13.8	14.6	14.2
" 21.....	18.1	17.5	18.5	" 5.....	13.3	14.6	13.2
" 22.....	19.1	18.1	17.0	" 6.....	13.2	14.6	13.2
" 23.....	18.2	19.3	18.7	" 7.....	13.2	14.1	14.0
" 24.....	18.1	18.5	17.2	" 8.....	12.6	14.2	13.9
" 25.....	17.2	18.5	18.4	" 9.....	13.3	14.7	12.9
" 26.....	16.8	17.1	17.2	Gen. Av.....	17.4	17.7	16.7
" 27.....	13.6	16.8	15.6	Maximum.....	40.0	39.0	30.0
" 28.....	13.8	16.6	16.0	Minimum.....	11.0	13.0	12.0
Mar. 1.....	15.4	15.1	14.6	M. V.....	3.69	2.80	2.52

Some of these curves show that the larger part of improvement is done during the first test. Usually, however, there was a constant, though slow, progress in improvement until the end of the twenty tests. Practise showed its influence to the end of the series, with every indication that the averages could, with further practise, be further reduced.

Secondary factors, such as fatigue, concentration of attention, indisposition, distraction, etc., all had great influence

¹One day short by oversight.

²Periods missed on account of sickness.

on the work. The conscious processes were very susceptible to these influences.

In learning the associations of the different keys mnemonics proved helpful, by taking notice that certain association letters formed initials of familiar names, etc., while some had to be retained by sheer force of memory.

In some cases the peculiarity in sequence of the letters or pairs of letters associated caused retardation in association processes.

Regarding the theory of interference upon completing one key and taking up a different one the writer believes that probably there is a certain degree of interference; he also thinks there is a certain amount of learning in the former key transferred to the new one, and that there is a resultant of forces present, which, in general, makes possible a lower time rate. In the present investigation there was constant lowering of the beginning time rate as progress from key to key was made; which, it would seem, shows conclusively that there was a transference of learning from one key to another, and that the evil effects of interference were largely neutralized.

A NOTE ON THE EFFECT OF RHYTHM ON MEMORY

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In spite of the poor standing of the "class" experiment, the writer has been so impressed by the similarity in the results of three such tests, that he thinks the data obtained will be of general interest to students of memory problems—the more so, as some of the conclusions are in direct contradiction to the results obtained in certain other investigations.

The object of the experiment was to test the effect of some of the various kinds of rhythm upon the memory for numbers. The rhythms used were the trochaic, iambic, dactylic, anapestic and amphibrachic forms, together with a non-rhythmic series. The investigation was carried on in the time-honored way. The material consisted of 9 and 10 digits arranged haphazard, for example, 381427695. Such a group was read at a rate of between 90 and 100 per minute. Eight such groups constituted one series. One 9 digit series and one 10 digit series were used for each of the different kinds of rhythm.

The rate of 90 to 100 per minute was used in the endeavor to obviate subjective grouping on the part of the subjects. and because it would be about equally advantageous for the two-part and three-part rhythms. According to Bolton's work upon rhythm, it was found that 75 per minute was the most favorable rate for two-part subjective rhythms, and 130 per minute for the three-part subjective groupings. The intermediate rate was therefore used, for this experiment concerned itself with objective groupings only. The subjects were instructed to write down as many of the numbers as they could remember immediately after the reading of one group. They were told to be sure to get the right number in the right place and to put dashes for the forgotten numbers,

so that those given correctly should appear in the correct place in the combination.

The results were recorded in the usual way. A number correctly given and in the right place in the combination was awarded a credit of 100 per cent. A transposition of two numbers was given half credit, or 50 per cent. What might be called a half transposition, or a number which was shifted one place to the right or left with an incorrect number appearing in its place, was given a value of 25 per cent. The results are consequently given in percentages of the total amount recalled.

The series were given in such a way as to obviate as far as possible the effects of practice for any meter. Frequent rests were given the subjects so that fatigue might not interfere with the results.

A total of 180 subjects was used, 80 men and 100 women, all of them coming from the class in introductory psychology at the University of Michigan. The first group, consisting of 50 persons, 25 men and 25 women, performed the experiment during the winter of 1911 and 1912. During the winter of 1912 and 1913 about 80 persons were experimented upon, and the papers of 25 men and of 25 women were selected at random. During the winter just passed (1913-1914) 30 men and 50 women performed the same experiment.

Since certain differences appear in the masculine and feminine types of reaction, it will be well to treat them at first separately and then note the sex differences. The following table shows the results registered by the men in the 9 digit series.

TABLE I
MEN. 9 DIGITS

Group	N. R.	Troc.	Iamb.	Dact.	Amph.	Anap.	Av.
1	74.1	75.0	78.9	85.0	—	89.7	80.5
2	77.0	73.2	71.2	88.5	80.4	83.5	78.9
3	71.0	68.2	72.0	88.7	83.7	88.8	78.7
Average	73.7	71.8	74.0	87.5	82.1	87.3	79.4

N. R. indicates that the numbers were read without accent,

or rather with the amount of accent as nearly uniform as possible. The other headings show the rhythm used—trochaic, iambic, dactylic, amphibrachic and anapestic.

Until the results of the third set of papers had been obtained, there was no intention of using them for anything but purposes of illustration in class. The records of two sets had therefore been destroyed before any individual characteristics had been worked out. Realizing that the averages as shown in the tables may be greatly affected by some extreme cases rather than representative of a general tendency, the writer regrets this loss. However, he has worked out the last set of papers not only in percentage values, but also in terms of position by The Order of Merit Method, where the effect of extreme cases is eliminated. There were no substantial differences in the results obtained by these two methods, certainly no differences of kind. There were a few differences of degree.

A study of the table brings out these facts:

1. There is a variation of 6 per cent. in the recall of the unaccented series amounting to 0.54 of one syllable when we compare the best group with the worst. There is no correlation between the ability to recall the non-rhythmic series and especial ability to recall any particular kind of metrical presentation. The one thing which does appear is that the group which had the highest recall value for the unaccented series had the lowest for the average of the three-part meters. This same relation will not hold for the other two groups, however, for the group which was the worst in the non-rhythmic series was not the best in the three-part rhythms, unless we omit the amphibrach. If we do omit the amphibrach entirely, we do find the reverse correlation, that the poorest group in the non-rhythmic series was the best in the three-part rhythms considered as a whole, while the best non-rhythmic group was the worst in the three-part rhythms.

Another interesting result which appears from a study of the table is that the group of men which did best in the non-rhythmic series did better on the falling rhythms, the trochaic and dactylic, than they did on the rising meters, the iambic

and anapestic; while those who were the worst in the unaccented series recalled the rising meters better than the falling.

2. In two out of three groups and in the average of the three groups, the trochaic form of rhythm has not as high a memory value as the non-rhythmic series.

3. In two out of the three cases and in the average, the iambic form of rhythm is better for the purposes of recall than the non-rhythmic series. We are justified in stating, then, that the iambic form of presentation is very slightly better than that without rhythm. Considering the average for the two-part rhythms, we find it to be slightly worse than the unaccented series.

But it must be remembered that the series of 9 digits read in two-part rhythm is scarcely a fair test, for one number is left over, making an incomplete foot at the end of the line. When this incomplete foot is unaccented, as in the iambic form, the group has a higher memory value, in two cases out of three, than when the incomplete foot is accented. It is interesting in this connection to call attention to the fact brought out by Miss Rowland in connection with visual rhythms, namely, that a change in the minor element of the series is more disturbing than a change in the major element.

4. The three-part rhythms are all better than the unaccented series. The dactylic and anapestic forms are about equal, with the dactylic very slightly in the lead and the amphibrachic is the worst, but better than the two-part and non-rhythmic series. It is entirely natural that the three-part rhythms should be the best in this part of the experiment, for most of us have been trained from our earliest days in the grade schools to group numbers by hundreds, thousands, millions, etc.

The following table shows the results registered by the women in the 9 digit series.

The study of this table shows the following facts:

1. There is a variation of 3.7 per cent. in the recall of the unaccented series amounting to 0.33 per cent. of one syllable when we compare the best group with the worst. Here we

TABLE IA

Group	N. R.	Troc.	Iamb.	Dact.	Amph.	Anap.	Av.
1	76.5	72.6	78.1	91.8	—	99.1	83.6
2	76.0	71.3	70.7	94.4	88.1	95.3	82.6
3	72.8	65.5	70.0	90.8	83.7	90.3	78.7
Average	74.5	68.1	72.2	92.0	85.0	93.7	80.9

find that the best non-rhythmic group is also the best in the two-part and three-part rhythm series, while the worst non-rhythmic group is also the worst for all forms of rhythmic presentation. The best non-rhythmic group is best in the falling rhythms, while the worst non-rhythmic group is best in the rising two-part and the falling three-part rhythms.

2. In all three tests, the trochaic form is not as good as the non-rhythmic.

3. The iambic form is in general below the non-rhythmic, but is better than the trochaic. Again, as with the men, the series having the extra unaccented syllable has a higher memory value than the series containing the extra accented syllable.

4. The three-part rhythms are considerably better than either the unaccented series or the two-part meters. The anapestic form is best, the dactylic next and the amphibrachic worst.

Averaging the results of the men and women in the 9 digit series, we find that the three-part rhythm is best, the non-rhythmic next and the two-part rhythm the worst of all. There is also a tendency for the rising meters to have a greater memory value than the falling ones.

Considering now the differences between the masculine and feminine types of reaction, we find:

1. The total amount recalled by women is greater than that recalled by men, 80.9 to 79.4 or 100 to 98.1.

2. In the non-rhythmic series, the women recalled more than the men absolutely, but relatively less. For when we consider that the women remembered actually more than the men did taking the series as a whole, the percentage of the series recalled in the non-rhythmic series is less for the

women by a ratio of 92.1 to 93.0. The non-rhythmic form of presentation, then, is relatively worse for the women than it is for the men in spite of the fact that they recalled more actually.

3. The two-part rhythm is better for the men, both absolutely and relatively, than it is for the women, the absolute ratio being 72.9 for the men to 70.1 for the women, and relatively 92.0 to 86.8.

4. The three-part rhythm is better for the women, both absolutely and relatively, by the ratio of 90.2 to 85.6 absolutely, or 112 to 108 relatively.

5. With the men, the dactylic form of meter had a somewhat higher memory value, while with the women the anapestic form was best.

Turning now to the consideration of the 10 digit series, which was given to but two sets of persons, we find a relative rise in the memory value of the two-part rhythms, and a relative decrease in the three-part, showing that the irregularity of the last foot was a determining factor. The total amount remembered in this series was considerably less than in the 9 digit series, as might naturally be expected. Table II. shows the results of the men in the 10 digit series.

TABLE II

Group	N. R.	Troc.	Iamb.	Dact.	Amph.	Anap.	Av.
2	71.0	69.7	72.7	77.1	—	76.9	73.6
3	62.3	63.4	69.0	75.5	71.2	73.0	69.1
Average	64.4	64.4	70.8	76.6	71.2	74.8	70.4

This table shows:

1. The recall of the unaccented series shows a variation of almost one syllable when we consider the results of the two groups. The best group in this series was absolutely the best in the three-part rhythms, but relatively worse than the other group. There is no evident correlation between the recall of the unaccented series and either the falling or rising rhythms.

2. The trochaic rhythm is equal to the non-rhythmic

series. This is true of the average, the two series differing somewhat. In one, the trochaic is better and in the other worse than the unaccented series.

3. The iambic series is better in both cases than the non-rhythmic. On the average, then, the two-part rhythm with series of 10 digits is better than the unaccented series.

4. All of the three-part are better than the two-part kinds of rhythm, the dactylic holding the highest place, the anapestic second and the amphibrachic coming last, as was the case in the 9 digit series.

The following table gives the results of the women in the 10 digit series:

TABLE IIA

Group	N. R.	Troc.	Iamb.	Dact.	Amph.	Anap.	Av.
2	63.5	68.5	69.8	72.9	—	74.3	69.8
3	61.0	64.1	65.4	70.4	68.5	72.2	66.9
Average	62.0	65.5	67.0	71.2	68.5	73.0	67.9

A consideration of this table brings out the following points:

1. There is very little variation between the two groups of women in the recall of unaccented material, only a quarter of one syllable. The group which was absolutely worst in the recall of the non-rhythmic series was relatively better in the recall of the three-part rhythms.

2. In both series, both forms of the two-part rhythm are better than the unaccented series. The iambic form is better than the trochaic.

3. Each of the three forms of three-part rhythm is better than either of the two-part meters. But with the women, the anapestic form of meter is better than the dactylic. The amphibrachic is lowest of all.

Taking into account the sex differences, we find that:

1. The total amount recalled by the men is greater than that recalled by the women, 70.4 to 67.9 or 100 to 96.5. Considered absolutely, the women recall less in all the different forms of rhythm. This is true of the average of the

non-rhythmic, two-part and three-part rhythms. The women did recall slightly more in the trochaic form. Considered relatively, we find the men to be better in the non-rhythmic series, worse in the two-part meters, and slightly better in the three-part rhythms, when we consider all the three-part meters together.

2. The men are best in the dactylic meter and the women in the anapestic.

The task would be incomplete if no endeavor were made to bring together the results of the 9 digit and the 10 digit series. It would, of course, be unfair to average them, but it is possible to take the average recall for each group and reduce the amount recalled for each kind of meter to a percentage of this average. This would do no injustice to any group considered alone and would make comparisons possible. Combining the previous tables for the men, and omitting the amphibrachic form of meter—for it shows nothing striking—we obtain this table:

TABLE III

	Group	N. R.	Troc.	Iamb.	Dact.	Anap.
9 digits.....	1	92.2	93.3	98.0	105.9	111.7
	2	97.4	93.6	90.1	112.0	105.8
	3	90.2	86.6	91.5	112.8	113.0
10 digits.....	2	96.7	94.8	99.0	105.0	103.2
	3	90.1	91.7	99.8	109.2	105.2
Av. of 9 digits.....		92.8	91.0	93.3	110.2	110.0
Av. of 10 digits....		91.5	91.5	100.6	109.0	106.3
Difference.....		1.3	0.5	7.3	1.2	3.7

The main value of this table seems to be to show the amount of damage done by introducing irregularity into the series. There is a difference of 1.3 in the non-rhythmic series in favor of the shorter groups. The two-part rhythms are better in the 10 digit series by an average of 3.9 and the three-part rhythms are better in the 9 digit series by an average of 2.45. On the average, the three-part rhythms seem to be affected less by the introduction of an irregularity than do the two-part, 3.9 to 2.45. Moreover the falling

rhythms are less affected by the extra measure than are the rising meters, 0.85 to 5.5.

TABLE IIIA

WOMEN

	Group	N. R.	Troc.	Iamb.	Dact.	Anap.
9 digits.....	1	91.5	86.8	93.5	109.9	118.8
	2	92.3	86.6	86.0	114.7	115.9
	3	92.5	83.2	88.9	115.2	114.6
10 digits.....	2	91.0	98.1	100.0	104.4	106.4
	3	91.2	95.8	98.0	105.1	108.0
Av. of 9 digits....		92.2	83.3	89.4	113.8	116.0
Av. of 10 digits....		91.4	96.5	99.0	105.0	107.6
Difference.....		0.8	13.2	9.6	8.8	8.4

This table shows that there is a slight relative difference—0.8—in the recall of the non-rhythmic series, the difference being in favor of the shorter series. The two-part rhythms are better in the 10 digit series by an average of 11.4 and the three-part rhythms are better in the 9 digit series by an average of 8.6. The two-part rhythm, then, is affected a little more by the introduction of irregularity than is the three-part rhythm. In both the two-part and the three-part rhythms, the falling meter is the more affected, 11 to 9. There is less disturbance of the three-part rhythms than of the two. The other points which are brought out by this table have been considered before, so may be omitted here.

When we consider the sex differences as brought out by a comparison of the results of the 9 digit and the 10 digit series, we find that:

1. The feminine recall is better for the 9 digit series by a ratio of 80.9 to 79.4 or 100 to 98.1, whereas in the longer series the masculine recall is better by a ratio of 70.4 to 67.9 or 100 to 96.5. Considering the whole experiment, then, the men have slightly better memories for numbers than the women, the ratio being 100 to 99.1. This difference is very slight and might be called negligible.

2. The irregularities introduced into the series are more disturbing to the women than to the men, 8.16 to 2.8.

3. The irregularity on the average affects the three part rhythms less than it does the two-part for both sexes.

4. With the men, the dactylic form of meter is the best in all cases; with women, the anapestic.

5. The irregularity affects the rising meters more than it does the falling in the case of the men; whereas the falling meters are more affected in the case of the women.

Since, as has been seen, the 9 digit series introduces a disturbing factor into the two-part rhythms and the 10 digit series into the three-part rhythms, it will be interesting to consider the two-part rhythm 10 digit series together with the three-part rhythm 9 digit series. The results obtained from this consideration differ from the rest of the results only in this particular, that, with one exception, any rhythm is better than no rhythm at all. This exception occurs in the case of the men and with trochaic rhythm, it being exactly equal to the non-rhythmic series.

This way of regarding the results also raises the feminine recall somewhat above the masculine, but shows that it is a more precarious thing, very easily disturbed.

DIAGNOSTIC VALUES OF SOME PERFORMANCE TESTS¹

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In preliminary mental examinations of a number of recent admissions to the Ohio Girls' Industrial School, the results obtained from the Binet and Point Scale ratings of intelligence, set apart three groups, which it seemed desirable to investigate further. These groups follow:

1. Twenty-one high-grade morons, whose Binet ratings average 11 years, with a mean variation of 3 years, and whose Point Scale ratings, transformed into years, average 11.6 years, with a mean variation of .4 year.

2. Sixteen, concerning whose intelligence defects we are in doubt, because of the disparity between the Binet and Point Scale findings. Binet ratings of these sixteen average 11.6 years, with a mean variation of .2 year. By Point Scale rating, these are all 12 years or more. One only is flat 12. Four are over 15 years.

3. Twenty-six, who show no defect in intelligence by either of these ratings, being twelve years or more by both scales. Fifteen of them get credits for more than the 82 points for fifteen years.

The actual ages of these sixty-three girls, reckoned by the nearest birthdays at the times of examination, range from 12 to 18 years. The median ages for each subgroup, in the same order as above, are 15.8 years, 16.5 years, and 16.5 years. The average ages for each subgroup, in the same order, are 15.2 years, 16 years, and 15.9 years. The median age of the sixty-three girls is 16.35 years, and the average age of the sixty-three is 15.7 years.

For the further study of these cases, recourse was had

¹ Read before Section L of the American Association for the Advancement of Science, December 31, 1914.

to the following tests. We lack standards in all these tests. For the more delicate diagnosis of intelligence and other mental defects in persons of mentalities of more than ten years, there is no method of procedure in any wise comparable for accuracy of measurement to the Binet and Point Scale for the earlier stages of development. These performances and other tests have been used widely as supplementary aids to psychologists' native intuitions. Methods of testing have been developed, but no standards of the meaning of results.

These subjects having been rated by the two scales (Binet and Point), and classified with respect to the 12-year line, we have a means of preliminary evaluation of these supplementary tests. We may ascertain which do and which do not correlate with the scales. It is not standardization. It is merely evaluation. Standardization is not possible with defectives.

LIST OF THE SUPPLEMENTARY TESTS

1. Picture Form Board (farm scene, mare, colt, chicken, sheep. Two right-angled triangular pieces to fit into an isosceles triangle). (Healy.)
2. Construction Puzzle (*A*). (Healy.)
3. Construction Puzzle (*B*). (Fernald.)
4. Labyrinth (*B*). (Boston Psychopathic Hospital.)
5. Visual Verbal Memory Test. (Schmidt.)
6. Auditory Verbal Memory Test. (Thorndike.)
7. Learning Test. (10 symbols for 10 figures; 4 lines.)
8. Cross Line Test (*B*). (Healy.)
9. Motor Coördination. (Whipple.)
10. Opposites. (Lists I. and II. of Woodworth and Wells.)
11. Completion Test. (Boston Psychopathic Hospital.)
12. Moral Discrimination Test. (Boston Psychopathic Hospital.) (For girls.)

Table I. presents, for comparison, the summaries of results, from each of the three groups of girls for each of the first eleven tests.

The *first four tests* were given with simple directions, and the time in seconds and the moves or errors, recorded. These are averaged for each of the three groups.

TABLE I.

Test	No Defect		Doubtful		High Grade Defectives		Evaluation
	Time in Seconds	Moves, Errors, Etc.	Time in Seconds	Moves, Errors, Etc.	Time in Seconds	Moves, Errors, Etc.	
1. Pict. Form Board..	102	7.4 errors	123	6.7 errors	151	8.9 errors	By time for both differences and for errors in defectives.
2. Const. Puz. (A) ..	52	11.9 moves	58	14. moves	78	16.6 moves	By time and moves for both differences.
3. Const. Puz. (B) ...	135	23.6 moves	185	23.3 moves	109	19.1 moves	No value.
4. Labyrinth (B).....	287	2. errors	321	2.4 errors	345	2.5 errors	Time and errors set off non-defective.
5. Vis. Verb. Mem. ...	58	11.8 details	56	12 details	59	10.1 details	Details set off defective.
6. Aud. Verb. Mem....	52	9.9 details	44	9.7 details	49	9. details	Details set off defective.
7. Learning... ..	114	.6 errors in 36s	107	.6 error in 33s	118	.5 error in 38s	No value.
8. Cross Line (B)....	—	.6 in 6	—	2.4 in 6	—	1.9 in 6	Errors set off non-defective.
9. Motor Coordin. ...	30	1.3 errors 79 taps	30	2.4 errors 79 taps	30	.6 errors 75 taps	No value.
10. Forty Opposites ...	324	2.1 errors	301	3.4 errors	396	9. errors	By errors both differences.
11. Completion.	346	2.8 errors	414	2.5 errors	420	3.3 errors	By time defectives are set apart. Errors possibly differentiated defectives. Time may possibly differentiate non-defectives.

In the *Visual Verbal Memory* test, a sheet was handed the subject on which the story of a fire was printed, one line to each detail, and she was directed to read it once aloud, and to do it carefully so she could remember as much as possible.

In the *Auditory Verbal Memory* test, the shipwreck story was read to her four times. Times for recall and numbers of details are averaged for each of the Memory Tests.

In the *Learning* test, times required to fill three lines, and to learn, to the subject's satisfaction, were recorded and averaged, as well as the numbers of errors in filling the 4th line from memory, and the times for the memory work.

In *Cross Line (B)* test, the double cross was drawn on a piece of paper and the arabic numerals, 1-9, written in the nine spaces. The explanation of how the symbols could stand for the numbers was accompanied by a drawing of each symbol as the number was named, and an illustration given of writing a symbol under a number. The subject was asked to note carefully the arrangement. The paper was then turned over and six numbers written in a line, and the subject asked to make the corresponding symbol under each.

In *Motor Coördination*, we average numbers of dots made in 30 seconds, and the errors, *i. e.*, dots on lines or outside of squares intended, or a second dot in a given square.

In *Opposites*, we average the time and errors (wrong words and omissions) for 40 words. The observer wrote the opposites and was not hurried.

In the *Completion* test, the same method and data were used.

From an inspection of the table it is at once evident that some of these tests give significantly different averages in each of the three groups; others reveal more or less clear differences as between the *not defective* (mentality of 12 years or more), and the doubtfully defective. Others show differences between the doubtfully and the definitely defective. Others still show no sufficient differences between averages of any two groups to make them of any diagnostic value in this part of the developmental period.

1. In the first class of tests, are (a) the Picture Form

Board, (b) Construction Puzzle (A), and (c) Opposites. In the Picture Form Board averages, there appear significant differences in the increasing time throughout, and increased errors in the defective. Construction Puzzle A gives marked differences in both time and moves. It seems a valuable means of differentiation in this region. Opposites by number of errors gives significant differences. Defectives are set off strikingly both by time and numbers of errors.

2. In the second class, the Labyrinth averages indicate some diagnostic value in differentiating between the "non-defectives" and the "Doubtfuls," both in time and number of errors. Both the verbal memory tests on the other hand seem to differentiate between the "high-grade defective" and the "doubtful" in the number of details recollected. The norms seem to be ten visual, and nine auditory details for the defective, and twelve visual and nearly ten auditory details for the doubtful. The Cross Line test again separates the normals and doubtfuls strikingly. The Completion test is much less valuable. It separates non-defective from doubtfuls by time, and doubtfuls from defectives by numbers of errors. The latter difference has most weight.

3. In the third class, Construction Puzzle (B), the Learning test, and Motor Coördination seem to be of no service for differential diagnosis in this part of the development of mentality from ten and one half years to fifteen.

We compare the *median place of location* of each one of the ten acts, in the Moral Discrimination test, for each of the three groups, and also for a group of fourteen first-year high-school girls of ages from 14 years to 16.5 years, with results as in Table II.¹ The figures give the median positions assigned each act by each of the four groups.

"Flirting with a nice young man" is deemed much worse by the normal girls than by any of the delinquents. Of the delinquents, the high-grade defectives consider it worse than the other subgroups.

"Taking a hair ribbon," is rated about six by all, *i. e.*,

¹ For the data from the reactions of fourteen high-school girls, I am indebted to Dr. R. Pintner, of Ohio State University.

TABLE II.

	Normal		Delinquent	
	¹⁴ 1st Yr. H. S.	²⁶ Not Defec.	¹⁶ Doubt. Intell. Defect.	²¹ High- grade Defec- tives
To flirt with a nice young man on the street.....	5.5	8.5	8.5	7.2
To take a hair ribbon from your employer when she knows nothing of it.....	5.7	5.8	6.2	5.9
To spend the night in a hotel with some young man.	3.5	2.7	1.8	2.5
To take a box of candy from the store where you work. . .	5.5	5.3	5.3	5.7
To tell a wicked lie about some girl.	4.5	6.1	5.7	5.7
To get mad and break the dishes when the woman for whom you work finds fault with you.....	8.5	8.6	8.2	7.5
To spank the baby because you are out of patience.....	9.3	8.1	8.7	7.3
To put poison in the food of some one whom you dislike.	2.4	1.9	2.4	1.9
Not to go to Sunday school and church, and never to read your bible.....	1.5	4.5	7.5	7.5
To throw scalding water on the cat.....	9.1	7.5	7.4	7.5

better than the middle. "Spending the night with a young man in a hotel" is rated a better thing to do by the normals than by any of the delinquents. Perhaps this is due to failure to understand what is meant. Of the delinquents, those of doubtful intelligence defect place it nearest the worst thing to do.

"Taking a box of candy" is placed about 5.5 by all groups. "Telling a wicked lie about a girl" is much worse with the normal girls than the delinquents. The delinquents all place it about the same, but those without intelligence defect consider it least bad. "Breaking the dishes when scolded" is worse for the high-grade defectives than any other group. "Spanking the baby when out of patience" is least bad for the normal girls, and judged worse by the high-grade defectives than by the other delinquents. "Putting poison in the food of one you dislike" is rated about the same by all, but some worse by the high-grade defectives and those of no intelligence defect.

"Not going to Sunday school and church" is the worst of the ten offences according to the normal girls. It is moderately bad for the delinquents with no intelligence defects, and moderately good for the doubtfuls and defectives. "Throwing scalding water on the cat" is the second best

act with the normal girls, and is moderately good for all the delinquents.

There are no significant differences between the groups of delinquents in regard to their moral judgments. This test is of no value for differential diagnosis as between these groups. The startling moral judgments of the normal girls suggest the need of psychological inquiries into ethical foundations in the minds of girls.

By our findings then, the values of the tests for differential diagnosis of our three groups are as follows:

1. *Tests of Value for Both Distinctions*
The Picture Form Board.
Construction Puzzle (A).
The Opposites.
2. *Tests Good for Differentiation of the Not Defective from the Doubtful*
The Labyrinth (B).
The Cross Line (B).
3. *Tests Differentiating the High-grade Defective from the Doubtful*
Visual Verbal Memory.
Auditory Verbal Memory.
4. *Tests of Doubtful Diagnostic Value*
Completion.
5. *Tests Showing No Definite Diagnostic Value*
Construction Puzzle (B).
Learning.
Motor Coördination.
Moral Discrimination.

TABLE II.

	Normal		Delinquent	
	14. 1st Yr. H. S.	26 Not Defec.	16 Doubt. Intell. Defect.	22 High- grade Defec- tives
To flirt with a nice young man on the street.....	5.5	8.5	8.5	7.2
To take a hair ribbon from your employer when she knows nothing of it.....	5.7	5.8	6.2	5.9
To spend the night in a hotel with some young man.	3.5	2.7	1.8	2.5
To take a box of candy from the store where you work. . .	5.5	5.3	5.3	5.7
To tell a wicked lie about some girl.	4.5	6.1	5.7	5.7
To get mad and break the dishes when the woman for whom you work finds fault with you.....	8.5	8.6	8.2	7.5
To spank the baby because you are out of patience.	9.3	8.1	8.7	7.3
To put poison in the food of some one whom you dislike.	2.4	1.9	2.4	1.9
Not to go to Sunday school and church, and never to read your bible.....	1.5	4.5	7.5	7.5
To throw scalding water on the cat.....	9.1	7.5	7.4	7.5

better than the middle. "Spending the night with a young man in a hotel" is rated a better thing to do by the normals than by any of the delinquents. Perhaps this is due to failure to understand what is meant. Of the delinquents, those of doubtful intelligence defect place it nearest the worst thing to do.

"Taking a box of candy" is placed about 5.5 by all groups. "Telling a wicked lie about a girl" is much worse with the normal girls than the delinquents. The delinquents all place it about the same, but those without intelligence defect consider it least bad. "Breaking the dishes when scolded" is worse for the high-grade defectives than any other group. "Spanking the baby when out of patience" is least bad for the normal girls, and judged worse by the high-grade defectives than by the other delinquents. "Putting poison in the food of one you dislike" is rated about the same by all, but some worse by the high-grade defectives and those of no intelligence defect.

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By our findings then, the values of the tests for differential diagnosis of our three groups are as follows:

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The Labyrinth (B).
The Cross Line (B).
3. *Tests Differentiating the High-grade Defective from the Doubtful*
Visual Verbal Memory.
Auditory Verbal Memory.
4. *Tests of Doubtful Diagnostic Value*
Completion.
5. *Tests Showing No Definite Diagnostic Value*
Construction Puzzle (B).
Learning.
Motor Coördination.
Moral Discrimination.

PROCESSES REFERRED TO THE ALIMENTARY AND URINARY TRACTS: A QUALITATIVE ANALYSIS¹

BY E. G. BORING

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Recently the writer promised a descriptive study of certain complex organic processes that have their origin in the alimentary canal and the uro-genital system.² The present paper, which fulfills that promise, presents introspective descriptions of thirst, hunger, nausea, the call to defecation, defecation, the call to urination, and urination. Descriptive accounts were obtained, a few in the series of the earlier experiment, some in subsequent series, and others from written reports prepared by the observers outside the laboratory when the particular complex was experienced. These reports are more reliable than the usual answers to a questionnaire, because they were written down at the time of the experience by trained observers who had consciously adopted the attitude of psychological observation. It is from such accounts that quotations are made in all cases where there is no specific indication of another source.

The procedure was to provide each observer with a booklet which contained space for the description of the various processes mentioned above. At the beginning of the book was the following instruction:

You are requested to give as careful an introspective description of the various complex organic processes listed herewith as possible. Please select a time when the particular process is intense, and arrange to retire from distractions and write a careful report on these pages.

In the description of the complex organic processes, the observer is advised not to avoid *Kundgabe* or common-sense language, but to deal freely in the meanings of processes as well as in their pure description. It is instructive to be told that a complex feels 'as if . . .' or 'like. . .'. In description, free use should be made of such unsystematic descriptive words as sharp, keen, piercing, lancing, thrusting, insistent, dull, diffuse, definite, pungent, hard, clear, bright, heavy, full, steady, stable, etc. It

¹ From the Psychological Laboratory of Cornell University.

² 'The Sensations of the Alimentary Canal,' *Am. Jour. Psych.*, 26, 1915, 1.

should be borne in mind, however, that the exact significance of such words is not such that it always leads to a clear and unequivocal interpretation, for their meanings differ from individual to individual. The sensations should therefore, whenever possible, be compared in quality with such better known sensations as those of the cutaneous and, possibly, of the kinesthetic senses. The observer should also be on the watch for such characteristics as are matters of extension or of temporal course, and should, when able to do so, localize the complex as accurately as possible within the body.

There were nine observers,—six men (*A, B, C, D, E, F*) and three women (*X, Y, Z*). Four of the observers (*A, B, X, Y*) had received the doctorate in psychology; three of these were instructors in psychology. Two others (*C, Z*) were graduate students. The rest were undergraduates in the advanced courses in the laboratory.

THIRST

Observers *A, B*, and *X* undertook to go without water or liquid food for long periods, and to keep a running account of the experience. Abstracts from their reports follow.

Observer A.—6:30 P.M. Began experiment.

9 A.M. (14½ hrs.) "Tongue coated. Saliva secreted rather freely. It is rather that I want a drink than that I am thirsty. Pressure and kinesthetic complex in my mouth (not throat) keep reminding me at intervals of the experiment, and I imagine how a drink would feel."

2:30 P.M. (20 hrs.) Warm day. "Have eaten a few figs. Saliva still quite actively secreted, and mouth and throat kept wet by swallowing frequently and licking mouth with tongue. Lips are getting dry. The thirst rather expresses itself in my imagination than in sensation changes. While I am doing other things, I suddenly break off automatically and start for the water faucet, without thinking of what I am doing. Once I got the water turned on before I thought."

4:30 P.M. Ate piece of cheese.

5:30 P.M. (23 hrs.) "More unpleasantness now. A little more intense tactual sensations in mouth. Saliva secretion seems less. Slight headache. Number of times that I start for faucet increased; I should think I have started twenty times in the last hour. The start is like this: I am working and come to a break in the work; automatically I start to get up and move in the direction of the faucet. The tactual sensations in the mouth and the kinesthetic sensations in the tongue are then in the background. Then there is usually a vague visual image of a glass for water or a visual image of the sink or basin toward which I have made my involuntary start. Before I have moved more than a bit with my body, before I have taken a step, I get a kinesthetic shock or check, and remember the experiment. It then takes me some time to get back to work. The images of the basin or faucet persist. I can not keep them out of mind. This, is, for the most part, where the unpleasantness comes in. The unpleasantness does not seem to attach to the mouth sensations at all. The sensations are not strong. They seem like tactual pressure, are superficial, and spread out over the roof of the mouth. They are not in the cheeks, on the tongue, or in the throat back

of the root of the tongue. The weakness and paucity of mouth and throat sensations is the striking thing so far."

11 P.M. Ate three cakes.

1 A.M. (30½ hrs.) "Weak in legs. Headache partly gone. Have taken a bath and am less irritable. Starts toward faucet and images of drinking less frequent. Roof of mouth very dry, an intense and thick tactual pressure with a very little livelier sensation almost like cutaneous pain or the prickle that one gets in drinking lemonade. In back of roof of mouth a narrow arch of deeper, duller sensation, more intense, of the quality of muscular pressure. Some time ago there was mixed with this a deep, dull pain, almost like a muscular cramp."

10 A.M. (39½ hrs.) "Slight headache; tactual sensations in roof of mouth; tendency to keep licking roof of mouth and to swallow at saliva, which is scant and seems thick. There are frequent temptations to drink, which differ from the involuntary starts for the faucet in that they arise only when the mouth sensations catch attention. Lips chapped." At this point the experiment was discontinued.

Observer B.—Midnight. Began experiment with a drink of water. 9 A.M. (9 hrs.) "Tongue coated. Feel as if water would be good for me, but would taste unpleasant. Not thirsty. Mouth dry and sort of puckered—drawn."

9:30 A.M. Ate cake of almond chocolate.

11:30 A.M. (11½ hrs.) "Not thirsty. Mouth a trifle dry."

1:30 P.M. (13½ hrs.) "Beginning to get thirsty. Thirst consists of sensations from tongue, roof of mouth, and throat,—principally tongue. Flow of saliva copious. I keep moving my tongue about on roof of mouth. Tongue and roof of mouth feel sort of dead, when brought together. Mouth feels dry, a little bit drawn or puckered. There is nothing in these complexes when I get them clear but pressure; they mean thirst, *i. e.*, they tend to run off into visual imagery of water or kinesthesia of going for water. This tendency for the focus to shift makes it hard to keep the sensations, as such, clear. The pressures are easy to refer below the surface, though they remain on the surface too. I can feel the whole tongue affected, and, at times, this feeling does not seem to be pure pressure, but an ache-like pressure, perhaps muscular pressure. The ache is not explicit; I could not analyse it out. The sensation is more like the fore-runner of an ache. I also feel a slight ache in the back of each jaw, almost a cramp, like the ache from eating something too sour." B also fully describes the impulses to go for water that were noted by A.

2 P.M. Ate three slices of bread and a little jam.

5 P.M. (17 hrs.) "Thirst getting insistent, a puckered, swollen, dry feeling in tongue, cheeks, and roof of mouth. Lips very dry. Also a vague cenesthetic ache or weakness. I am a little unsteady upon my feet, and can not articulate with certainty."

5:15 P.M. Ate piece of cheese. 11 P.M. Ate a few crackers and smoked. Midnight: a few more crackers.

Midnight (24 hrs.) "Thirst insistent. Consists merely of dry mouth (pressure). Slight ache in head and limbs. Weak all over. Nothing new." The starts for the faucet are still reported.

10 A.M. (34 hrs.) "Feel pretty good. Mouth dry. Saliva no longer free. General body aches diminished. Impulses to get water less frequent."

10:30 A.M. Ate crackers and cheese.

1 P.M. (37 hrs.) "Very thirsty. Mouth getting actually dry. Lips have to be moistened constantly. Impulse to get water very strong. Chief symptom is general weakness and lassitude. Going upstairs tires me out.

"I tried experiment of putting cracked ice in a thin rubber bag in my mouth. Just as good as a drink! However, pleasant cold in mouth sets up impulse to swallow. If I swallow it as far as my throat, the cold in the throat is even more pleasant than that in the mouth. This surprises me because I have very few thirst sensations in my throat and ordinarily do not notice my throat. It is perhaps barely dry and aches a little, but I have no desire for water there until I put the bag of ice water in my mouth. The thirst disappeared entirely as long as the bag was in my mouth. The bag even felt wet, although it was actually dry. I could not keep it in long, however, because my mouth soon ached from the cold. On removing it the thirst returned immediately. As soon as the ice in the bag had melted, it ceased to be effective."

3 P.M. Ate buttered toast and ham. Rather weak. B found that two drops of acetic acid on the tongue "tasted good" and relieved the thirst for 7 minutes. Thirst had returned in its former intensity after 15 minutes.

4 P.M. (40 hrs.) "Headache. Mouth and face warm. Limbs ache. Mouth very dry, a dull pressure complex, with brighter surface qualities."

7 P.M. Ate toast, ham, and cheese.

10 P.M. (46 hrs.) "Tired, achy, weak. Mouth almost parched. Coated and a bitter taste. Lips have peeled a little; feels as if cheeks might soon. Headache."

2 A.M. (50 hrs.) Same as before. The thirst is a "dry mouth (cutaneous and subcutaneous pressure) and a taste." The rain outside reminded B of water and prevented his sleeping, so he discontinued the experiment at this point with a quart of water and some crackers. The mouth tended to dry quickly after the first drinks, but five minutes later he was quite comfortable. The next morning there were no noticeable effects of the water fast.

Observer X.—8 A.M. Began experiment.

8 A.M. (24 hrs.) "Thirst began to show itself by dryness of the lips. I did not clearly realize that I was thirsty, but found myself at intervals going to the water cooler. All along I was being reminded that I had certain sensations in my mouth that indicated thirst by finding the motor habit of securing a drink set off. Later the feeling of dryness extended beyond my lips to the inside of my mouth, especially the roof, which felt somewhat as if shrivelled. My tongue began to feel changed in shape; it seemed to be smaller, rounder, rather swollen at the back. Later the dry, somewhat irritated, rough feeling increased in the roof of my mouth and extended to my throat as well. I now feel as if I had a 'dry sore throat.' There are little 'painful' sensations in my throat and on the upper surface of my tongue. My dry lips no longer bother me. The sensations on my tongue feel very much like those that I have after I have scalded my tongue by drinking something too hot. What moisture there is in my mouth seems to have got thick and sticky. The different parts of my mouth have a tendency to stick together when I try to spread them out."

4 P.M. (32 hrs.) "Mouth cavity insistently calls attention to itself. Throat seems hot, and inflamed, and sore; mouth somewhat dry and sticky; tongue achy and sore. There are dull pains, with perhaps a dull pressure, localized inside the tongue at its base. Dried-up feeling on top of tongue." Experiment discontinued at this point.

Extracts from reports of thirst experienced under less extreme conditions by other observers follow.

Observer C.—"Dryness expresses the complex as a whole. The qualities seem to be a little warmth, a little pain, which is very mild but seems to be quite important as a

component, and a quite distinct pressure. The pressure is like the result of stretching the skin, as if the mucosa had become shrunken and were stretched by a too voluminous submucosa. These sensations come from the sides and back of the throat in the region of the uvula, actually from little more than the soft palate. In the mouth there is a sort of stickiness or dryness."

Observer D.—"Feeling of dryness in throat. Feels cottony."

Observer E.—"A taut feeling of the upper esophagus and back of throat. Tongue feels large. Saliva thick and sticky. Sort of achy feeling in tongue and roots, extending to near-by parts of throat."

Observer F.—"Uncomfortable pressure in mouth, rather 'puckery,' localized in middle and back of tongue and roof of mouth. Also a more vague pressure in upper throat, not 'puckery.'"

Observer Y.—"Light pressure in mouth cavity and soft palate; faint muscular pressure at junction of jaws; perception of wetness under tongue (saliva). Pressure most prominent. Later pressure sensations at junction of jaws and also in cheeks became more intense and clearer. The perception of 'warm-dryness' in mouth was less prominent, but by no means obscure. Finally general muscular sensations took on a weak sort of tired feeling."

Observer Z.—"After eating too much candy: 'Tongue puffy and furry, rather warm and dry(?). Strong imagery of glass of water, of coolness of glass in hands, of coolness of water in mouth and throat, and of coolness of water in stomach.'"

From the foregoing reports it is evident that mild thirst consists predominantly in the going to get a drink, or in imagery which anticipates a drink; that is to say, thirst may not be conscious as such, but may be merely the meaning of a complex situation. Mild thirst is accompanied by a pressure-pattern on the tongue and the roof of the mouth, and sometimes by one in the throat. This pattern, which is seldom prominent in weak thirst, becomes marked as thirst gets more intense. Then the pressures increase in intensity and spread more frequently to the throat; the saliva flows freely, and the sensations involved in swallowing it figure in the complex. After a longer period of thirsting (twelve to twenty-four hours) the saliva no longer flows freely, the mouth becomes 'thick' and 'sticky' and 'dry,' the lips are dry and have to be moistened frequently. The pressures of the mouth are referred farther below the surface and, at least in the case of the tongue, take on the ache-like character of intense muscular pressure. The oral sensations touch off the desire to get a drink. In a still more extreme stage, the painful qualities become more marked in the tongue, in the roof of the mouth, and sometimes in the throat. There is

general bodily lassitude and weakness. There is no evidence of any qualitative peculiarity other than the pressure-pains of usual organic experience. It is the situation and not the specific quality that makes the experience one of thirst. The oral sensations that are typical of thirst are referred always to the mouth and sometimes to the throat. When they are felt in the throat they are usually much less intense than those in the mouth, and some observers, even in extreme thirst, do not find them in this region at all. Obviously the statement of the textbook of physiology, that 'our sensations of thirst are projected more or less accurately to the pharynx,'¹ needs revision.

It appears that the thirst-perception in the mouth can be adequately neutralized, for short times at least, by a perception of wetness, even though the wetness be illusory. Cold ice-water in a rubber bag, which is dry on the outside, afforded one observer complete relief. The bag felt wet, like a draught of cold water.

HUNGER

The recent physiological work which has resulted in the correlation of hunger with stomachic contraction has naturally suggested a tentative psychological definition of hunger. Cannon and Washburn² have separated hunger from appetite and characterized the former as an 'ache.'

"Appetite is related to the previous sensations of the taste and smell of food; it has therefore . . . important psychic elements. It may exist separate from hunger as, for example, when we eat delectable dainties merely to please the palate. Sensory associations, delightful or disgusting, determine the appetite for any edible substance, and either memory or present stimulation can thus arouse desire or dislike for food.

"Hunger, on the other hand, is a dull ache or gnawing sensation referred to the lower mid-chest region and the epigastrium. It . . . is likely to grow into a highly uncomfortable pang, less definitely localized as it becomes more intense. It may exist separate from appetite, as, for example, when hunger forces the taking of food not only distasteful but even nauseating. Besides the dull ache, however, lassitude and drowsiness may appear, or faintness, or headache, or irritability and restlessness such that continuous effort in ordinary affairs becomes increasingly difficult. That these states

¹ Howell, W. H., 'A Text-book of Physiology,' 1908, 272.

² Cannon, W. B. and Washburn, A. L., 'An Explanation of Hunger,' *Amer. Jour. Physiol.*, 29, 1912, 441. See also Cannon, W. B., 'A Consideration of the Nature of Hunger,' *Pop. Sci. Mo.*, 81, 1912, 291.

differ with individuals—headache in one, faintness in another, for example—indicates that they do not constitute the central fact of hunger, but are more or less inconstant accompaniments, for the present negligible. The dull, pressing sensation is the constant characteristic, the central fact, to be examined in detail.”¹

Carlson² also distinguishes between appetite and hunger, although he disagrees with Cannon and Washburn in regard to the nature of appetite. Hunger is pain.

“Pure hunger, not accompanied by ‘appetite,’ can be experienced, if during hunger attention is fixed on the hunger pangs themselves. . . . When this is done, hunger in its various stages becomes different degrees of pain.”³

“It seems to me that the pain experienced from contractures or ‘cramps’ in skeletal muscles and in the intestines is different from hunger pangs, even though pain is inherent in hunger. The difference may be only an apparent one, due to the fact that the latter pains arouse the memories of previous agreeable experiences with food.” “It would . . . seem that hunger contains elements of kinesthetic sensation as well as pain, the latter predominating in strong hunger.”⁴

The observers in the present experiment were asked to report upon ‘hunger’ only, under the following instruction:

“The observer is warned to distinguish between ‘hunger’ and ‘appetite.’ Hunger is more nearly ‘sensational’ and is said to be always experienceable in isolation when the attention is directed toward it. Hunger usually ceases as soon as food is taken. Appetite is more ‘ideational’ and persists after food is taken. It is the desire for food, the opposite of aversion. Appetite probably constitutes the motive for eating dessert at any meal. We are here interested in the description of hunger only.”

In spite of this limitation the observers reported general weakness and faintness, headache, visual and oculomotor disturbances, factors which they recognized, however, as secondary to “hunger proper.” The qualitative nature of the more immediately relevant experience may be shown by extracts from the reports.

Observer A.—At noon after eating no breakfast: “Dull pressure of considerable intensity in area above umbilicus. With this also pain, an achy, gnawing pain. Or else a muscular tension, a feeling of muscular contraction in this region, gives the meaning of ‘gnawing.’ I think I sometimes have mere ‘emptiness,’ i. e., all this complex except the gnawing, achy pain, but this is only a general impression. It is common for me to say, ‘I am empty, but I am not hungry.’”

¹ Pp. 441 f.

² Carlson, A. J., ‘Contributions to the Physiology of the Stomach. II. The Relation between the Contractions of the Empty Stomach and the Sensations of Hunger,’ *Amer. Jour. Physiol.*, 31, 1913, 175.

³ P. 186.

⁴ P. 189. For another discussion of hunger as pain, and a resultant symptomatology, see Jones, A. A., ‘Hunger Pain,’ *Jour. Amer. Med. Assoc.*, 59, 1912, 1154.

Observer C.—"On the sensory side hunger is composed of temperature and muscular sensations. The temperature is warmth, in the main, but at times there is something resembling cutaneous paradoxical cold. What I have called muscular sensation seems to be a sort of strain or pressure, much like that from the contraction of any skeletal muscle. The localization is in the stomach, and that organ feels as if it were pulling itself into a knot just as the hand does when the fist is quite tightly clenched."

Observer D.—"A dull, yet insistent, ache,—very diffuse. It seems to cover an area of about 20 cm. diameter, fairly deep, and extending upward from the point of the sternum. Sometimes it becomes more intense for an instant at some point. This point changes continually. At times the diffuse ache becomes weak and gives way to a sharper pain, a little higher up. This lasts about a minute and then there is a return to the previous conditions."

Observer E.—"Hunger begins with an unpleasant, uncomfortable feeling below the sternum. This gradually and quickly changes to a raw painful feeling, as if of the rubbing of the two stomach walls together. This feeling of achy, rubby pain increases in intensity until even the esophagus seems to be uncomfortable in its lower parts."

Observer F.—"There seem to be general pressures all through the abdomen, rising up to and above the sternum. They are most definite in the region just below the sternum. They sometimes become a dull ache. (The whole thing is instable and fluctuates, coming and going at almost rhythmical intervals.) They become more definite when the attention is directed toward them. Sometimes there is a 'sharp-hot' pain just below the sternum."

Observer X.—"After 20 hours' fasting: 'Hunger is such a 'total' experience that it is difficult to pick out what should be labelled specifically 'hunger sensations.' In fact, I doubt if there are any particular sensations that I should label specifically such. I call them hunger sensations, I believe, because I have found regularly that, if I eat, they disappear. Otherwise I should be inclined to label them as: a 'weakness' complex, or a 'feeling of emptiness,' or 'throaty sensations,' according as one or another aspect of the experience became prominent."

"What I feel at present is (1) a general bodily weakness, such that I am inclined to do nothing in the way of work, not even stand, and (2) a particular kinesthetic complex in the region of my diaphragm. Perhaps the latter is also part of the weakness; respiration certainly is not so strong and deep as normally. There are also (3) sensations which I localize in my digestive tract. Some of these I localize in my stomach. They make up the core of the empty, 'gone' feeling. They appear to be vague, dull, quite persistent kinesthetic sensations, as if from contractions of the stomach. They make a definite peculiar complex, but I believe that it is a complex composed of pressures and kinesthesia,—dull, but definite; very strong and insistent at times, but never sharp or bright or clean-cut. Besides the sensations in the stomach, there are others, localized in the back of my throat, at the beginning of my esophagus, which seem like incipient swallowing movements (esophageal kinesthesia). They draw my attention very decidedly to that region; when I attend to them there is a very strong inclination (in visual and kinesthetic terms) to put food in my mouth. The thought of food seems to make the salivary glands more active, so that I occasionally actually swallow. The upper part of my digestive tract seems very ready to react, and is evidently incipiently active,—judging from the sensations. The feeling of 'wanting something' is localized in my throat. The throat sensations are quite steady and persistent."

Observer Y.—"Strong, gnawing pressure (gnawing is elemental, a kind of pain). This complex is unpleasant and means a need of food,—hunger. There is also a com-

plex localized in the pharynx, and muscular sensations in the jaws. Also a perception of wetness, localized under the tongue, meaning much saliva. The complexes localized in the stomach and pharynx together make up the desire for food. The pharyngeal complex is the less prominent."

Observer Z.—This observer reports that she seldom has the intense and vivid 'hunger of childhood' and that she has been unable to induce it for the sake of the experiment. In addition to describing general faintness, however, she gives, after a short fast, and under the caption 'Emptiness,' the following report. "Slight headache and light feeling. No desire for food as food, but knew from experience that it would take away the 'empty' feeling. Experience a slightly unpleasant pressure, localized in bottom of stomach; pressure in throat from about larynx to top of back of mouth; pressure of tongue on roof and sides of mouth (I think this is thirst); tongue felt bigger and softer than usual. The pressure on the bottom of the stomach seemed just like the pressure of a heavy weight on a relaxed muscle, although it was not so intense."

The writer has described elsewhere a case in which hunger was induced in one subject by the introduction of HCl into the stomach.¹ A few sentences will suffice to show that this 'laboratory hunger' does not differ from that occurring under more usual conditions.

Observer B. After 5 c.c. of 5 per cent. HCl: "Hunger, a strong, intense, diffuse ache, varying in intensity and covering an area as shown [*i. e.*, an area extending from the umbilicus to the sternum]. There is an especially intense and achy spot at [a point a little above the umbilicus and to the left]. Hunger goes and then returns; then lasts a long time, getting gradually fainter."

In another trial, a warmth was reported to "die away very slowly, fusing into a general ache in the stomach region. This ache gets more intense and presently without qualitative change turns into hunger."

Again, a 'stinging pain' is supplemented by a 'dull ache' below the sternum. "The ache spreads downwards, and, as the sting disappears, it turns into hunger pains. The hunger pains are marked, but are shot through by a little stinginess, a brighter and more tingling pain."

The hunger-complex is a complex of pressure and pain. Upon a background of dull pressure (*A, B, C, F, X, Y*), which is sometimes recognized definitely as kinesthesia or the equivalent muscular pressure, there is set a dull ache or gnawing pain which characterizes the hunger (*A, B, D, E, F, Y*; the intense muscular pressure of *C* is also pain; muscular pressure goes over into ache-like pain, which observers often call pressure).² Two observers (*X, Z*), who failed to find the pain-quality, also had difficulty in determining just what

¹ *Op. cit.*, 48.

² Cf. the confusion of pressure, strain, cramp, and pain in the introspections of esophageal pressure, especially those of *G*, *op. cit.*, 28 ff.

constituted hunger. Both pain and pressure are referred to the region of the stomach. The pain is noted as fluctuating, as rhythmical, as instable. In more intense hunger the maxima of the fluctuations of the 'dull ache' may involve a sharper pain-quality, which is definitely localized and limited to a very small area (*B, D, F*). 'Emptiness' appears to consist of the typical pressure pattern of hunger without the algesic components (*A, Z*). Three observers (*X, Y, Z*¹) describe a complex kinesthesia in the throat and of oral sensations arising from the free flow of saliva, a complex which means for them desire for food, appetite, a literal watering of the mouth. Here we have the true sensory basis of 'appetite.' The ideation of food (mentioned specifically by *X*) is no doubt a usual concomitant, and presumably it often constitutes a desire for food that lacks sensory components entirely. There can be no question that this desire for food—appetite, if one is not disposed to limit the term too closely—may also often be unconsciously carried, just as in thirst the 'appetite' for water may become manifested automatically in the movements of going for a drink (see pp. 307, 310).

Our reports enable us to supplement Cannon's description by many reports of psychologically trained observers. But we have gone farther than confirmation. Hunger is a twofold experience. It is pressure in its weak form, pain and pressure when intense. If one calls the intense experience 'hunger' and the weak 'emptiness,' one has changed the phraseology but not the fact. Moreover, weak hunger appears to be muscular pressure, and intense hunger is the ache of intense muscular pressure. Carlson, we have seen, has also made this point: 'hunger contains elements of kinesthetic sensation as well as pain';² but he thinks that the pain is not 'the pain experienced from contractures or 'cramps' in skeletal muscles.'³ However, Carlson admits that the difference may be extrinsic rather than intrinsic, and he will doubtless welcome evidence for the muscular quality of the entire hunger-pattern.

It is not easy to follow Carlson in his discussion of appetite.⁴ He objects to the view that 'appetite requires a nervous organization capable of associative memory,' because we have "in appetite for food conditions as primitive and essentially fixed by

¹ The three women: but it would be overhasty to discover a sex difference. They found in general more difficulty in deciding just what hunger was—perhaps, after all, their sex is a little less intimate with the inner man—and they gave fuller descriptions. Unable to find a *sine qua non*, they described all possible concomitants. Of course they thus noted complexes which the men overlooked.

² *Op. cit.*, 190.

³ *Ibid.*, 189.

⁴ *Ibid.*, 185 ff.

inheritance as in the case of the sexual desires or 'instincts'." Appetite becomes 'the desire for food,' 'the expression of an inherited mechanism.' "The inheritance factor in appetite, the desire to eat, is in some way caused by the hunger pains." When appetite apparently occurs alone, it is due to a concomitant 'subconscious hunger.' Three factors make up the food-taking impulse: hunger (pain), appetite (desire for food; a sensation?), and 'memories of the taste and smell of foods.' There would appear to be seven possible cases: (1) hunger alone (pain), when one attends to the hunger sensations; (2) hunger and desire for food (pain+appetite), when in extreme hunger one eats disgusting food; (3) desire alone (subconscious hunger pains+appetite), the non-rhythmical 'hungry-feeling' of Carlson's subject; (4, 5, 6) any of these states together with 'memories' of food—the usual impulses in food-taking; (7) 'memories' alone, 'the contemplation of a favorite dish after a full and satisfying meal.' So much we are told. But we have no hint as to the nature of appetite. Is it a sensation? is it a group of sensations? if so, what is it like? We do not ask for technical psychology. If it is sensory, what makes it so fundamental that it must be reflexly aroused? And why, in particular, must hunger, already defined as 'different degrees of pain,' be its sole condition? And what is this conditioning hunger, conscious and 'subconscious'? Is it sensation? or is it the nervous substrate of sensation? or is it the physiological cause of the hunger pangs? Until these questions are answered Carlson's distinctions will prove of little service.

If, however, classification and definition in such a simple case are wanted, the writer would suggest the following schema:

Hunger-complex	Hunger	= muscular pain	} Sensory
	Emptiness	= muscular pressure	
	Appetite	= throat-mouth sensations	
Desire for food	Imaginal desire	= imagery	} Imaginal
	Unconscious desire	= determining tendency	
			} Neural

It seems probable that such an account would be accepted by Meumann,¹ who has laid stress upon the variety of the digestive sensations. Meumann describes three typical digestive experiences. In the first place there is the 'hunger sensation,' which 'is localized not only in the mouth and in parts of the throat, but also quite definitely in the stomach,'² a complex equivalent to hunger *plus* appetite as given above. In the second place, there is 'the very characteristic sensation of emptiness of the stomach,' a sensation which "has a very different character from the tension or pressure sensation of the abdominal wall. It can become intensified in a very unpleasant way and is sometimes connected with a vague perception of the peristalsis of the stomach."³ just such a complex we have also called 'emptiness.' Finally, after eating, there is 'a characteristic sensation of fullness and pressure in the stomach' or, as it is called in another place, 'satisfaction and fullness.'⁴ The experience is said to be not one of mere extension, as it is partially independent of the amount of food taken, and to some extent dependent upon the kind of food. Our introspections do not cover this point. Hertz has described the experience and concluded that it is conditioned upon the

¹ Meumann, E., 'Zur Frage der Sensibilität der inneren Organe,' *Arch. f. d. ges. Psychol.*, 9, 1907, 28ff.; 'Weiteres zur Frage der Sensibilität der inneren Organe und der Bedeutung der Organempfindungen,' *ibid.*, 14, 1909, 279 ff.

² *Arch.*, 9, 52.

³ *Arch.*, 14, 293.

⁴ *Arch.*, 9, 51 f.; 14, 295. The writer does not interpret Meumann as meaning to distinguish between 'fullness' and 'satisfaction,' although it is possible to make such a construction.

tension of the muscular coat of the stomach, a tension of which the effectiveness is independent of muscular tonus.¹ Sternberg, it should be noted, distinguishes between appetite, hunger, and satisfaction.²

NAUSEA

Nausea was experimentally induced in the laboratory by the administration of syrup of ipecac or by a decoction of tobacco and, in one case, by the smell of castor oil.

Numbers below in brackets indicate the time in minutes that has elapsed since the beginning of the experiment.

Observer A.—2 teaspoonfuls syrup of ipecac. [23] "Breathing sensations queer. Feeling like that of respiration in abdomen, but shorter and quicker than breathing. I feel as if I were 'ready to vomit,' which is a meaning. My stomach feels a bit fuller. The tone of my muscles in arms, chest, and abdomen seems to have gone down; I feel weaker." Q. "Is this nausea?" A. (after thinking): "Yes . . . Saliva is forming. Tendency to open my mouth. Sweat comes on. Contractions of stomach, almost painful. Breathing is irregular. I close my eyes. [He vomits five times.] Big muscular wrench. Characteristic muscular weakness. Weeping. Throat and stomach feel full. Achy pains across stomach. I think I feel most nauseated just before I vomit. It feels as if my stomach actually sank. To the best of my knowledge that is like muscular pressure. There was a very, very slight dizziness in my head."

Observer D.—4 teaspoonfuls syrup of ipecac. [1] "Begin to feel something. A sort of sharp ache under sternum." [3] "Dull, heavy ache around stomach region." [15] "Something runs the whole length of my esophagus, up to the back of my throat; it means a desire to vomit. . . . It is taking on a nauseous character. I feel it mostly in the back of my throat; it seems to spread all over from the stomach up; considerable pressure to it. [He vomits violently.] Felt just as if there was a pressure there at bottom of esophagus up to throat. . . . Now I am getting unsettled in stomach. This seems to be a diffused pain, localized at least two inches below sternum. With it there is pressure, which means nausea and which gets more intense, meaning impending vomiting." [21: vomits again.] "Just preceding the vomiting the pressure gets very intense. It seems as if that pressure forced the contents right out. While vomiting I felt violent contractions in my stomach. . . . Nausea is coming again now. The first thing is pain. It is now at the top of my stomach [indicates level of sternum] and now lower down. There is also a band of pressure, below the sternum. Rather suggestive of gripes." Q. "What sort of pain is this pain that comes?" A. "Diffuse, sort of dull. It gets very intense. Not the pain of a prick at all. It seems as if the pain and the pressure constitute nausea. The pressure alone means incipient vomiting. . . . In some ways the pain is more of an ache than a pain; I suppose an ache is a dull pain. It is quite diffuse." [40: vomits.] "Frightful unpleasantness seems to cover up everything. There is a bodily trembling—a general feeling of weakness."

¹ Hertz, A. F., 'The Sensibility of the Alimentary Canal,' 1911, 19 ff.

² W. Sternberg's classification is into (1) disgust, (2) appetite, (3) hunger, (4) thirst, (5) feeling of satisfaction; 'Der Hunger,' *Zentralbl. f. Physiol.*, 23, 1909, 105. For his distinction between hunger and appetite, see in particular: 'Physiologische Psychologie des Appetits,' *Zeitschr. f. Sinnesphysiol.*, 44, 1910, 254; 'Das Appetitproblem in der Physiologie und in der Psychologie,' *Zeitschr. f. Psychol.*, 59, 1911, 91.

Observer Y.—5 teaspoonfuls syrup of ipecac. [15] "Dizziness. Pressure sensations in stomach,—a dull pressure, unpleasant, slightly nauseating, a sort of gnawing, a sickish character. Pressure gives a sinking feeling. Occasionally muscular sensations, as if I were about to vomit." [20: vomits.] "I'm not sick or squeamish; it was muscular." [22] "I am sick now. A gnawing, sinking, pressure-like quality in stomach region, extending up a little under sternum. A trifle dizzy, but the stomach-complex is strongest. Pressure-like quality seems to irradiate from the stomach, and I feel generally squeamish. The feeling extends all over me." [24: vomits 5 times.] "Nausea got very strong before vomiting. Muscular sensations are part of it. They were fused with a 'sinking,' which got worse and, as it got worse, gnawing." [25: vomits twice.] "I do not know whether the sinking, gnawing quality is something new in the element-line or not, or whether it is the character of the total complex. It belongs to the pressure family. It may be that there is a dull pain or ache, although it is not what I usually mean by an ache. It might be an approach to a fused non-intensive ache. Certainly its identity as such, if such it is, is so merged in pressure, that it appears more like a coloring, a dull, gnawing, sinking affair. I am rather inclined to think that the 'gnawiness' is in part of the achy character, but that pressure is the clear and stronger component. It is all closely fused—a unique whole." [35] "The gnawing is more prominent than the sinking. Yes, it is something aching; I am quite sure now. It is dull pain, very different from pin-prick, and yet something of the same order,—at least, a pain. . . . The achy character is more prominent than before—a gnawing."

Observer Z.—6 teaspoonfuls syrup of ipecac. [36: vomits several times.] "Feel awfully funny in throat; the muscles feel all tight, and yet the throat feels as if it were bigger than usual. I think that, except when I felt the contents coming up, I did not have any sensations at all below the bottom of my neck." Q. "Would you say you were nauseated?" A. "No, I do not think I was. Generally, as well as I can remember, nausea is decidedly unpleasant in both stomach and throat." Z failed to get any nausea within an hour and went home. There she became quite sick (i. e., vomited) during the night, and recorded at one time the following: "Vague moving pressures, localized in stomach. Slight dizziness and weakness. Spasmodic contraction of muscles over whole trunk, especially in throat. Tears; perspiration." She did not record at the time whether or not the complex was one of nausea, although in the morning, upon being questioned, she was inclined to think that it was.

In order to obtain a nausea which would be more persistent than that induced by the ipecac, two observers took doses of a strong solution of tobacco juice.

Observer B.—2 teaspoonfuls of tobacco juice. [5] "Esophageal sensations, weak, but qualitatively like those in swallowing a hard object. Faint pressure in stomach,—a very vague ache." [15] "Gentle achy pressure in stomach region. Also vague aches from arms, like muscular fatigue. Whole thing makes up 'sick feeling.' Attention to any one part seems to break it up." [19] "When I smell the tobacco juice, a wave of achy pressure travels down the esophagus. It is nauseous." [24] "It seems as if nausea were in this case: general bodily weakness (mostly muscular fatigue)+headache (swimming sensations, eye-pressure-aches, tightness at ear, pressure wave at back of head; eye-aches and swimming most prominent)+*intense unclear* pressure-aches around sternum. It seems as if stomach sensations had to be unclear in nausea; attention to them spoils the complex as nausea." [37] "Incipient vomiting sensations, in

which stomach-aches get more intense and extend up farther and aches in eyes get intense. This is nausea. I also sometimes get stomach-pressures, which mean incipient vomiting, but which are less achy." [80] "The nausea is particularly difficult to localize; it is fleeting, evanescent, by which I think I mean merely that it (or at least the achy complex) is intermittent. Attention always goes naturally to the head sensations. When I voluntarily attend to the stomach-sensation, it always turns out to be an ache; and, since it seems to remain as continuous as any process in changing from obscure to clear, I say that achiness is its normal character. But attention never goes voluntarily to these sensations. I say they are essential because I always find them when I hunt for them while I am feeling nauseated. The principal part of the nausea as regards intensity and clearness is the headache, swimming, and (just now) jaw-aches (crampy character); but I do not think that they could be nausea without being supplemented by the stomach sensations, *i. e.*, I think the stomach-complex gives the meaning nausea."

Observer E.—2 teaspoonfuls of tobacco juice, 50 per cent. dilution. [7] "I begin to feel quite sick now,—a sort of dizziness in head; also pressure in stomach. Feeling of great discomfort all the way up from stomach to throat. More intense at times. Also a little pain, a peculiar ache, a sort of dry achy tenseness. It is very intense every time I smell the tobacco. Also a dull ache in head." [11] "Convulsive movements in the stomach or esophagus." Q. "Would you say you were nauseated?" A. "Yes." [20] "Still a discomfort in stomach. It is almost pain." [165] "Feel sick in my throat. There are aches in my stomach."

Of all the observers, *A* had the greatest difficulty in characterizing nausea. The nausea described above (ipecac) for him was not intense nor was it probably typical. The strong, characteristic experience could invariably be induced, however, by the smell of castor oil. His introspections under these conditions follow.

Observer A.—Nausea induced by smell of castor oil. "With the smell of the oil there was a big shiver, together with a wave of cold, all over my upper chest and abdomen—even in my arms. There was a sensation which has something in it of the sinking sensation that you get down here [umbilicus to sternum] when you drop in an elevator. There is also a start of a vomiting reflex, a muscular, pressury sensation; it seems as if I could feel a contraction. There is a bit of dizziness in head also. I feel myself sweating a bit. . . . Both what is the start of a vomit and the sinking thing are, I think, pressury. . . . The pressure in the stomach region is a pressure down." After another trial: "I do believe that there is something that I haven't mentioned yet, a sensation which forms a part of this whole situation. It is very hard to localize; certainly, however, somewhere in the trunk. I can describe it only as a sickening sensation, a kind of an awfulness and helplessness. It is not intense, if you can talk about its intensity absolutely. The other things were definite and stood there and waited for you; they caught your attention. This sensation is there beside,—a sickening, an awful helplessness." At another time *A* assumed the attitude which stands for this 'awful helplessness': the body is relaxed, the knees slightly flexed and the arms hanging limp, the body bends slightly forward, the abdomen in, the head is inclined, the mouth is open, the eyes are closed. After another experiment: "I don't know! If it is a meaning, it's the meaning of the smell. And how can the meaning of the smell be down in

my chest and abdomen—for that is where I feel sick? This is the case: I do feel sick. And I feel sick down here. Now there are a lot of sensations down here that I can put my finger on and localize.”

The confusion of the ache of nausea with the ache of hunger came out in the experiments that were made upon *B* with stimulation by HCl (*cf.* p. 314).

Observer B.—After the introduction of 5 c.c. of 20 per cent. HCl into the stomach. “Ache in stomach region became definite and was recognized as nausea. It was most intense about 3 cm. below sternum. The nausea lasted a long time (I still feel a little bit sick.) It is a pain, very much like hunger.” After 5 c.c. of 5 per cent. HCl: “Nausea. I feel pretty sure that ‘sickness’ is the nausea ache below the sternum *plus* muscular pressure down toward the umbilicus, the latter meaning violent contractions, as if I were going to vomit. I do not believe that the ache is in any way different from the ache of hunger, except that it is a little more diffuse, a little higher up, less likely to be localized and less definitely localized when it is, less intense, and without the rhythmical intensive fluctuations of hunger.”

Observer D volunteered a general statement that is relevant: “I can not always tell hunger from nausea. When I am nauseated [he is subject to spells of indigestion] I generally stop eating. At such times I decide to begin with my meals again as soon as I feel hungry, but I can not always tell when to start in, because I can not always tell whether I am hungry or still nauseated.”

The reports show that the experience of nausea is very complex indeed. All sorts of factors are mentioned: dizziness or swimming sensations in the head, the sensations aroused by too free a perspiration, aches and pressure-pain complexes in the head, in the eyes, in the jaws, in the arms, general bodily shivers and chills, general weakness. Besides these factors, which sometimes constitute the most prominent part of nausea, there are the sensations which are referred to the alimentary tract proper. Pressure-complexes referred to the stomach, or pressure-waves localized in the esophagus, indicate incipient vomiting and are often present.¹ Other alimentary pressure-sensations, however, appear to be more nearly integral to nausea: the ‘sinking feeling’ and the dull ‘sickishness’ are described as purely pressure, the ‘gnawing pressure’ and even the ‘ache’ are probably partly pressure. With the exception of *Z*, in whom the occurrence of a true nausea is open to doubt, and of *A* in his series with castor-oil,

¹ It is this complex, apparently, that E. Murray describes as ‘revulsion . . . sometimes grading into a feeling of nausea’ (‘Organic Sensation,’ *Amer. Jour. Psychol.*, 20, 1909, 437). To Murray belongs the credit of having obtained introspections upon nausea under experimental conditions. Unpleasant odors were used as stimuli.

all the observers agree that nausea involves a dull ache or pain in the stomachic region. Two observers (*B*, *D*) declare that this ache is indistinguishable in quality from the pain of hunger, and one (*Y*) implies the similarity by describing it at first as a 'gnawing pressure' and coming later to the conclusion that it was an 'ache.'

Which of these factors are essential to nausea, and which are occasional concomitants? Dizziness, headache, bodily weakness, shivers, perspiration, and so forth are by no means invariably present. No one is essential, and all may be absent. They occur more frequently as concomitants, or perhaps indicators, of an intense nausea. The pressures of the vomiting reflex are often absent, and were distinguished by most of the observers as separate from nausea. Their concurrence seems to be only casual; they have not come to mean nausea. Frequently they occur without nausea in vomiting.¹ The pressures of the 'sinking sensation' and the dull ache seem to be the most constant components; but the pressures are lacking in the hunger-like nausea that *B* reports for stimulation by HCl, and the pain is not found by *A* in the intense nausea induced by castor oil. Apparently, then, there is no sensory factor that is invariably present in nausea. The facts become intelligible if we regard nausea as a meaning, a situation. Various organic factors, alimentary or general, may combine in nausea, or (at least after the more complex experience has been had) a few or even one of the more usual constituents may mean the whole situation. Nausea for different persons, or for the same person at different times, may thus be very different. The significance of the nauseous situation is such that one is not likely to adopt even a casually introspective attitude toward it; hence, even if there are variations from time to time in the same person, the qualitative differences are still not likely to be noticed. Nausea involves a condition of the digestive tract, and undoubtedly the alimentary pattern of pressure and ache is the usual result of

¹ In the present experiment both *A* and *Z* vomited without nausea. In the experiments previously reported by the writer (*op. cit.*) nausea was as infrequent as vomiting was common. Observer *F* in that experiment was almost never nauseated; but see the account of vomiting on pp. 6 and 12.

the conditions which produce nausea. In a hypoalgesic individual, nausea may never reach the ache-stage. By association with the pressure-ache complex, or with what may by a given person be regarded as symptoms of nausea (*e. g.*, vomiting, loss of appetite, disgust, weakness, etc.), other sensations may come to stand for the nausea or, in a given case, to constitute the habitual form of nausea.

The foregoing hypothesis not only explains the apparent uniqueness of the nausea experience (a factitious uniqueness, acquired by the failure of the observers to observe sensory quality), but also avoids the implication that a unique experience must have a unique qualitative basis. The positive reduction of nausea to organic pressure and pain is not, however, an easy task. The whole pattern is so complex, the unity of the situation is so insistent, the fusion of the elements appears in consequence so intimate, that analysis is difficult. *B* observed that attention to some parts seemed to destroy the whole, and *Y* declared that the complex as a whole, intimately fused, constituted nausea. *A*, as a matter of fact, was not always able to make the analysis. He could find nothing but organic sensation of pressure-like quality, but he was not sure that there was not something else, 'a sickening sensation, a kind of an awfulness and helplessness.' When asked to describe, he was unable to do more than to assume the 'helpless attitude' (see p. 319). In view of the fact that all the other observers made the analysis, the inability of *A* to reduce the complex does not seem to warrant the assumption that it involved a new element. In a more general context, Titchener has remarked that the impossibility of reduction in a single case need not imply elementariness if the analysis can be made by other individuals or in other instances;¹ and it appears as if we had here chanced upon an attitude so intimately fused that its reduction was, under our conditions, not always attainable. It should be remembered, too, that *A* himself was not sure that the unique residuum was not the 'meaning of the smell.'

¹ Titchener, E. B., 'Experimental Psychology of the Thought Processes,' 1909, 171.

THE CALL TO DEFECATION

Descriptions of the call to defecation and of the act itself were written down by the observers at the time of occurrence.

Observer A.—"Slight strains and dull pressures of weak intensity in abdomen are all that I can find as sensations."

Observer G.—"The call to defecation is a wave of pressure of quite general distribution and not easily localized. It is somewhere in the lower abdominal cavity and finally reaches the rectum. When this wave has run its course there sets in a general pressure which includes the whole abdominal contents. At high intensities the muscular contractions of the abdominal wall and of the sphincter are added to the former complex. These sensations are just those of normal contracting muscle."

Observer D.—"Insistent pressures in rectum. Faint but slightly achy pressure in front wall of abdomen. Slight achy pressure in temples, which feels as if blood-vessels were distended."

Observer E.—"The call to defecation is a very pleasant experience. It seems to consist of a feeling of fullness, of distension of the bowels. Pressure, which is most prominent, is at first rather indefinite and equal in all directions, but later becomes a downward one. Sometimes aches and pains in the intestine accompany it."

Observer F.—"At first, vague, diffuse pressure in lower abdomen, not particularly unpleasant. Soon, however, it becomes a dull ache and often sharply painful. There also comes an ache about the anus, which often becomes 'hot' and 'burny'; and this is accompanied by violent contractions of the sphincter muscle."

Observer X.—"First noted impulse to go to toilet. The observed vague sensations localized in region of large intestine, a vague perception of movement in that part of the intestinal tract, like a very remote dull pressure that changed its location. Also, sensations of incipient movement in anus; a somewhat rhythmic movement of distension abruptly checked each time by movements of contraction. All this was quite involuntary. The internal movement (intermittent) renewed itself more intensely, but just as vaguely; the localization of it was far from definite. The relaxation-phase of the anal movement tended to increase in duration and intensity. After a time the checking, contracting movement ceased to occur involuntarily. Now there was a definite sensation complex, meaning pressure against the anal opening from within and above."

Observer Y.—"Intense deep pressure, probably muscular, located in region of anus. Soreness (of the pain modality) fused with the pressure. The complex was unpleasant."

Observer Z.—"Dull, diffuse, rather heavy pressure, localized rather vaguely in lower abdomen. Neither pleasant nor unpleasant."

In experiments described elsewhere, the writer has shown that the call to defecation may be induced in all degrees of intensity by the inflation of a rubber bladder within the rectum; that small amounts of warm water (50 c.c., 50-70° C.) produced the call very intensely (although an equal amount of cold water at 0° C. did not); and that HCl (10 c.c., 5 per cent.)

may also constitute an adequate stimulus to the call.¹ The description already printed calls attention to the specific sensation of muscular pressure in the rectum (a muscular 'ache' in intense degrees); to the widespread general abdominal response, apparently secondary and dependent upon muscular contraction; and to the pains, which, when the call is most intense, occur in great variety of quality and reference. A few quotations will render the reference explicit:

Observer B.—After the inflation of a bladder in the rectum 10 cm. above the anus: "First pressure in rectum. Then call to defecation, which differs from the first pressure in that it is more intense, covers a larger area, and has a temporal course of varying intensity (pulsations). Later pain was introduced. From then on intensity increased by jumps. The increase of pain was the most noticeable. The pain was of the achy variety, but got sharper and brighter, more definite and lively, although always diffuse, as the intensity increased. I think the pressure also increased in intensity, although it was largely obscured by the pain. Vague general pressures in abdomen were also noticeable. Still later pain was very intense; it was really very sharp and tended to run off into shoots and stings of pain. The temporal course up to this point shows, I think, all degrees of urgency for defecation. The urgency is not only a matter of intensity, but varies with the area affected and also with the quality of pain. . . . On the release of the pressure there is a tremendous relief, very definite in the region of the umbilicus and in the rectum. It is exactly like the relief of defecation without the sensations of passage. It is kinesthetic pressure."

After the introduction of warm water into the rectum: "Violent call to defecation includes pains and partially initiated movements at rectum. More or less confined to rectal region. General muscular effort in resisting call, even to the circulatory warmth of the face. Call is predominantly a pressury ache overshot with more intense thick pains of the achy variety. Besides this there is a general muscular irradiation." In another trial: "Intense grippy pains about umbilicus. They also shoot down into testes and penis. The abdominal pain has the peculiar character of 'belly ache.' There are also pains in the rectal region, such as occur when it is hard to hold in with an urgent call." At another time 'shivers over whole body' are noted.

After the introduction of dilute HCl: "Sets up the pressure complexes of the call to defecation in rectum at once; very intense. There is in the call also a dull ache; but I should not say that its unpleasantness is dependent upon the intensity of the pain."

The call to defecation is predominantly abdominal pressure. The pressure may mean distension or contraction or movement or effort; it may be weak or intense; it may be dull, diffuse, and vaguely localized or it may be clear-cut and accompanied by a definite visual reference. Of the nine

¹ *Op. cit.*, 50-54. Hertz's observations, *op. cit.*, 28 ff., have shown that the call produced by inflation of a bladder arises in the lower rectum. His descriptions do not indicate, however, the widespread nature of the response nor its painful character in high degrees.

observers five (*B, D, E, F, Y*) find that the experience involves aches or pains; two of these (*B, F*) also find 'sharp pains.' Besides the general abdominal complexes, definite rectal pressures are mentioned by *B, D, X*, and *Y*. *B* notes that the rectal pressures involve the ache of extreme muscular pressure. Two observers (*B, Y*) mention that the call is unpleasant, two (*E, Z*) that it is indifferent, one (*D*) that it is pleasant.

B's fuller introspections for the intense call indicate that the course for increasing intensity is more or less as follows: (1) muscular pressure in rectum; (2) rectal pressure becomes intense and achy, general abdominal pressures develop; (3) dull pain introduced; (4) sharp, piercing pains, of uncertain and varying reference, appear. There is no indication of the presence of qualities not ordinarily included in the pressure-pain group.

DEFECATION

Reports relating to the experience of defecation itself are as follows:

Observer A.—"Dull pressures in abdomen; increased strain in abdominal muscles. Pressure in rectum, localized two or three inches above anus. Sensations of cutaneous pressure and of strain as feces pass. Slight sweat."

Observer C.—"At the act of defecation [following the call to defecation] there is no new quality in the abdomen, unless the diminishing pressure due to decreased volume might be considered as such. In the rectum and at the anus, however, the moving contents may be felt as waves of pressure. . . . The only quality that I can find is just pressure, except at times pain, which does not seem to be normal."

Observer D.—"Increase of pressure throughout abdomen and especially in rectum. Bright stingy pressure at anus, which is pleasant and which carries the meaning of expulsion."

Observer E.—"Defecation itself is pleasant. In it a feeling of relaxation and a pressure, bearing down, are mixed."

Observer F.—"First the sensations of relaxation of the sphincter and abdominal muscles; then those of the moving pressure at expulsion."

Observer X.—"Movement of issuing feces somewhat perceived somewhere in the large intestine (as vaguely dull, indefinite, moving pressure, rather rhythmic in its fluctuations of intensity), but chiefly precisely at the anal opening. Here there was a definite clear-cut experience: very strong, bright, 'moving' contact and large pressure sensations; occasional pain elements, sharp and bright. Slightly shivery sensations ran up spine, and to some extent seemed to well out from the anal region. Felt 'goose-fleshy.'" At another time: "Noted that preliminary internal sensations were stronger, more definite and steadier. They included dull, diffuse, deep pressure with a vague, weak subcurrent of dull pain. Occasionally there were sharp, knife-like streaks of pain."

Observer Y.—"Defecation-complex is made up of the following factors: muscular sensations in anus; soreness, which was more distinctly painful in character, and which varied in intensity during defecation; and, I think, another kind of pressure, located at the distal end of the anus and meaning contact of waste-products with that part. There was also present a feeling of general strain."

Observer Z.—"Contraction of many muscles of abdomen with resulting strain sensations. More intense muscular sensations localized in rectum; pressure localized vaguely in the same place. During and after the contraction of the muscles, a pain of a moving pressure."

As defecation follows the call, the abdominal contractions that induce it are sensed as strain (*A*, *Y*, *Z*) or as pressure (*D*, *X*). The dull rectal pressure increases in definiteness and intensity and ordinarily becomes painful (*C*, *D*, *X*, *Y*, *Z*). This pain may be a dull ache or soreness (*X*, *Y*) or it may be bright, stinging, sharp, and knife-like (*D*, *X*, *Z*). *D* and *E* describe the experience as pleasant, *D* specifying that it is the 'stinging pressure' which is pleasant. This introspection agrees with that of the writer. In general, it may be said that the experience of defecation is little more than a heightening of the call to defecation, with a consequent introduction of algescic elements, and with perceptual additions relating to the passage of the feces.

THE CALL TO URINATION

The descriptions of urination and of the call to urination were obtained in the same manner as those of defecation.

Observer A.—"Weak sensations, very much like muscular pressure, spread over an area high inside of body with base just above the pubic bone. Later these sensations became slightly stronger in intensity and seemed more straining in quality, although they were still of weak absolute intensity. In the penis, especially the lower part (urethra), there were very weak sensations like contact and very weak cutaneous pain combined. Also a cool sensation in the glans near the opening. Still later I noticed weak straining sensations referred to the penis throughout its length and to the body. The sensations were strongest at the opening of the urethra."

Observer B.—"Dull pressure-ache, like that of intense muscular pressure, referred generally to region of penis, scrotum, and pubes. Localization not specific, for complex appears big and round, and attention to any particular organ makes the sensation appear to go elsewhere although it remains in the same general region. The penis is, however, always involved; the dull ache is most intense there. Dull pressure without ache centers in the pubic region. Besides the dull ache there is a sharper ache referred to the penis in a region about half-way between the root and the glans. It is very much like a 'sting' that is spread out. It varies quite regularly in intensity, intense pulses being separated from weak ones or from periods in which there is no ache at all. [I have had

an assistant note the time of these fluctuations for 5 min. There were 30 maxima in this time, an average separation of 10.1 ± 3.6 secs. Ten times the pulsations died out entirely. About once a minute there is a long interval, which serves to divide the pulsations into groups.] Ordinarily, I think, attention fluctuates, returning to the call when this sharp ache is most intense. When the call gets strong, there are muscular twitches—pressure sensations—prominent. Also a general restlessness."

Observer C.—"The call in its initial stages is intermittent and lapses with the application of attention. When it really becomes insistent it is very unpleasant. The components seem to be principally strain sensations from muscles and sensations of warmth. The first strain seems to be from the contractions of the bladder, at least it is in the lower abdominal cavity. It is a wave, moving from above downwards. At once this wave is met by a wall of pressure, and the two opposing strains seem to see-saw. The essential thing is *strain*, I think the resisting strain comes from the contraction of the sphincter muscles at the origin of the urethra. From this point lesser waves of pressure occasionally pass outwards to the distal end of the urethra. In addition to this pressure there is a sort of quality much like the pricking of a stiff hair applied to a pain or pressure spot in the skin. The bladder and the sphincter strains spread until the muscles of the abdominal wall are involved."

Observer D.—"The call to urination consists principally of bright stinging pressures in penis, mostly near the base. There is also a slight diffuse pressure higher in abdomen, which feels like the pressure of a filled bladder."

Observer E.—"The call to urination is a very pleasant thing, provided it be not too strong. It consists of a feeling of distension, of outward pressure."

Observer F.—"A vague indefinite pressure in the lower abdomen, rising as high as the umbilicus. Intermittent pain in the glans penis. Whole thing uncomfortable."

Observer X.—"The unintense experience of normal life is as a rule scarcely conscious; there seems to be an automatic reaction before the sensations become at all intense. . . . The experience, when intense, includes (1) a general bodily uneasiness, especially in the lower portion of abdomen; (2) a definite pain-complex, localized slightly below the middle of the abdominal cavity; it is an aching pain with something of the strained feeling to it; it is insistent, definite, persistent; (3) a vague feeling of 'repletion' of the abdominal cavity—a complex made up chiefly of dull pressures with perhaps a slight pain-component; (4) intermittent sensations, localized at the opening of the urethra. The 'general uneasiness' is centered upon this region, and the attention is drawn strongly to very bright and lively kinesthetic sensations of incipient movement there."

Observer Y.—"Warmth; and a sort of ticklish pressure, located in the region of the urethra and the bladder. The 'ticklishness' belongs to the modality of pain. This complex is set in a general muscular feeling."

Observer Z.—"Very slight warmth. Light diffuse pressure, spreading out through a comparatively small space and very poorly localized in the lower pelvic region toward the front of the body. Affective tone was indifferent."

All observers describe sensations of fullness or of pressure or of strain in the region of the bladder. *X* and *Y* refer an algesic quality to this region, and it is just possible that the strain noted by *A* and *C* is incipiently algesic. The most prominent part of the call for the male observers seems to

be, however, a pressure-pain complex, in which the pain dominates, and which is referred to the penis (variously to the base, the side in which the urethra lies, a point between the base and the glans, and the glans). All the male observers (except *E*, whose introspection is too scanty to be considered analytically) report pain. *A* finds 'weak cutaneous pain'; *B*, besides the 'dull pressure-ache,' a 'sharp, pulsating, intermittent pain'; *C*, a 'pricking pain'; *D*, a 'stinging pressure'; and *F*, an 'intermittent pain.' *A*, *B*, *C*, and *D* describe the pain as mingled with contact and strain, with pressure and muscular sensations, or with pressure. The reports of the women are quite similar. *X* notes an ache in the region of the bladder, and *Y* a 'ticklish' pain. *X* finds bright and lively kinesthesia at the urethra. For *Z* the experience is quite colorless—merely a diffuse pressure and warmth.

The affective judgments vary considerably. *B* finds the pains pleasant, and *E* reports that the whole experience, when weak, is very pleasant. *Z* records indifference, and *C* and *F* unpleasantness—at least when the call is intense.

URINATION

The act of urination is described as follows:

Observer A.—"Voluntary relaxation of the strains referred to the urethral opening, tactual sensations (like those from mucous membrane of mouth) and, at the very first, very weak cutaneous pain sensations, diffused through these tactual sensations, or spotted, peppered, around in them. These sensations are referred to the urethra, almost for the entire length of the penis. The whole experience was pleasant."

Observer B.—"Sharp aches, like the intermittent ones in the call to urination, become very intense just at the initiation of passage. They are referred to the same region as before, *i. e.*, above the glans, about one third of the way to the base. The aches get weak as passage starts and continue so until the end. Then, as the last dribble passes, they become momentarily intense again. After that they weaken and die out slowly during the subsequent minute. There are dull muscular sensations in the region of the bladder, which are not at all prominent. The relief afterwards is represented by the persistent aches in the penis, as described, and a large diffuse ache of the same quality in the region of the bladder. . . . All these sharp aches are very pleasant indeed. Even when one is restraining urination with much effort, the pulsations of pain are very pleasant. They are, I think, similar to, if not identical with, the sensations of the sexual organs at a low degree."¹

¹ The completion of urination is physiologically similar to ejaculation. The last portions of urine are expelled by rhythmical contractions of the bulbocavernosus muscle. See Howell, *op. cit.*, 785, 898.

Observer C.—"Strain in the muscles of expulsion but relaxation in the sphincter muscles. In the urethra there is a warm pressure, which persists just for a moment after the act is over. General relaxation marks the closing."

Observer D.—"At the beginning the pressure in the penis gives way to a tingling. This changes to a complex which I have not been able to analyse, but which means liquid flowing through the urethra. There is also general relief of pressure in the bladder."

Observer E.—"Pleasant, but I have not been able to reduce the experience to words."

Observer F.—"At first there is a sharp burning pain in the glans penis. Then nothing but the pressures accompanying the flow of urine. At the end there is a repetition of the beginning pain, only it is much stronger."

Observer X.—"Urination is accompanied by almost no sensations. There is a lack of the strain sensations experienced in trying to hold back the reaction,—a general bodily relaxation. There are very weak, bright, contact sensations at the opening. The pain sensations [described in the call in the region of the bladder] do not change in intensity or cease until some time after the operation is completed."

Observer Y.—"Muscular sensations in region of the urethra and bladder. Warm-pressure perception (flowing of liquid) and auditory perception (liquid striking water). This perceptual complex, set in a weak, general tension, present during urination. Afterwards a general feeling of relaxation, slightly pleasant."

Observer Z.—"Almost sensationless. Very weak pressure sensations, moving in scarcely perceptible waves,—just like the faintly discriminable changes in pressure you get from floating when in swimming. With these pressures, very weak muscular feeling of relaxed muscles all over and through the abdomen."

There has recently been reported to the writer a case of a woman who was unable on a railroad train to tell whether she was urinating or not. The noise of the train so obscured the usual auditory cues, she said, that she could not make the judgment. No doubt the jar of the train prevented any faint organic sensations, which may have been present, from being distinguished as cues.

Like the call to urination, in the men urination proper involves principally a pressure-pain complex in the penis. Some mention is made of muscular or strain sensations in abdominal regions, but the characteristic experience seems to be referred to the penis, and is caused, no doubt, by the distension of the urethra. Distention here, as elsewhere, may be expected to result in pain. The less experienced observers had difficulty in making the analysis. The others find in some cases tactual sensations, strains, or the less definite 'pressure.' Pain is possibly universal. *A* finds 'cutaneous pain,' *B*, 'sharp aches'; *F*, 'sharp, burning pain.' The 'tingling' of *D* implies pain, and, when one is familiar with the usual stinging response of the penis to warm stimulation, one is tempted to read an algesic quality into *C*'s 'warm pressure.'

In the women the experience seems to be as indefinite and colorless as it is striking in the men. *X* and *Z* call it 'almost sensationless,' and they are supported by the case last cited. Muscular sensations and weak contacts and pressures are noted in the effort to find something to report. A true sex difference seems to exist.

The experience is doubtless affectively indifferent for the women. Of the men, three (*A*, *B*, *E*) mention the affective aspect and all declare that it is definitely pleasant.

CONCLUSION

We may conclude that thirst, hunger, nausea, the call to defecation, defecation, the call to urination, and urination are all complex experiences reducible, under favorable conditions, to various patterns of pressure and pain.

The experiences may be very complex and may vary from individual to individual. Nausea is, perhaps, the extreme example. Different processes may stand for it at different times; and again, it may become so attitudinal as to defy analysis. Hunger is reduced to a single pain only by isolating it from appetite. Thirst is confined to the mouth and throat, frequently to the mouth only, but is definitely of the perceptual order. The excretory complexes are less frequently recognized as specific, and show a correspondingly wide variation in their many constituents.

The reduction to pressure and pain suggests the possibility of a number of qualities within each of those modalities. Besides occasional pressure of cutaneous quality, dull pressure and muscular pressure were the most frequent forms reported. As is usual, the muscular pressure in intense degrees runs off into painful ache. There were also sharp pains which, it may be, are of more than one kind.

Pain, although less usual than pressure, is by no means uncommon. It may be present in the throat in thirst; hunger is pain; the most constant constituent of nausea is the same pain as that of hunger; the call to defecation, when intense, involves sharp, shooting pains and dull aches; defecation may include stinging sensations at the anus; urination and

the call involve aches in the region of the bladder and, in the male, bright pain in the penis. These pains may be accompanied by any affective judgments whatever. The intense bright pain of urination may be very pleasant, while that in the call to defecation may be extremely unpleasant.

The present paper has been mainly analytical. The problem that it attacks must remain unsolved until the complementary synthetic operation has been performed. It is one thing to reduce a large part of organic experience to pressure and pain; it is another thing to say how many pressures and how many pains there are, how they differ from one another, and how they combine to form the typical complex processes of organic life. This second phase of the problem it is the writer's hope to bring into the laboratory.



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